MAR 9 1943

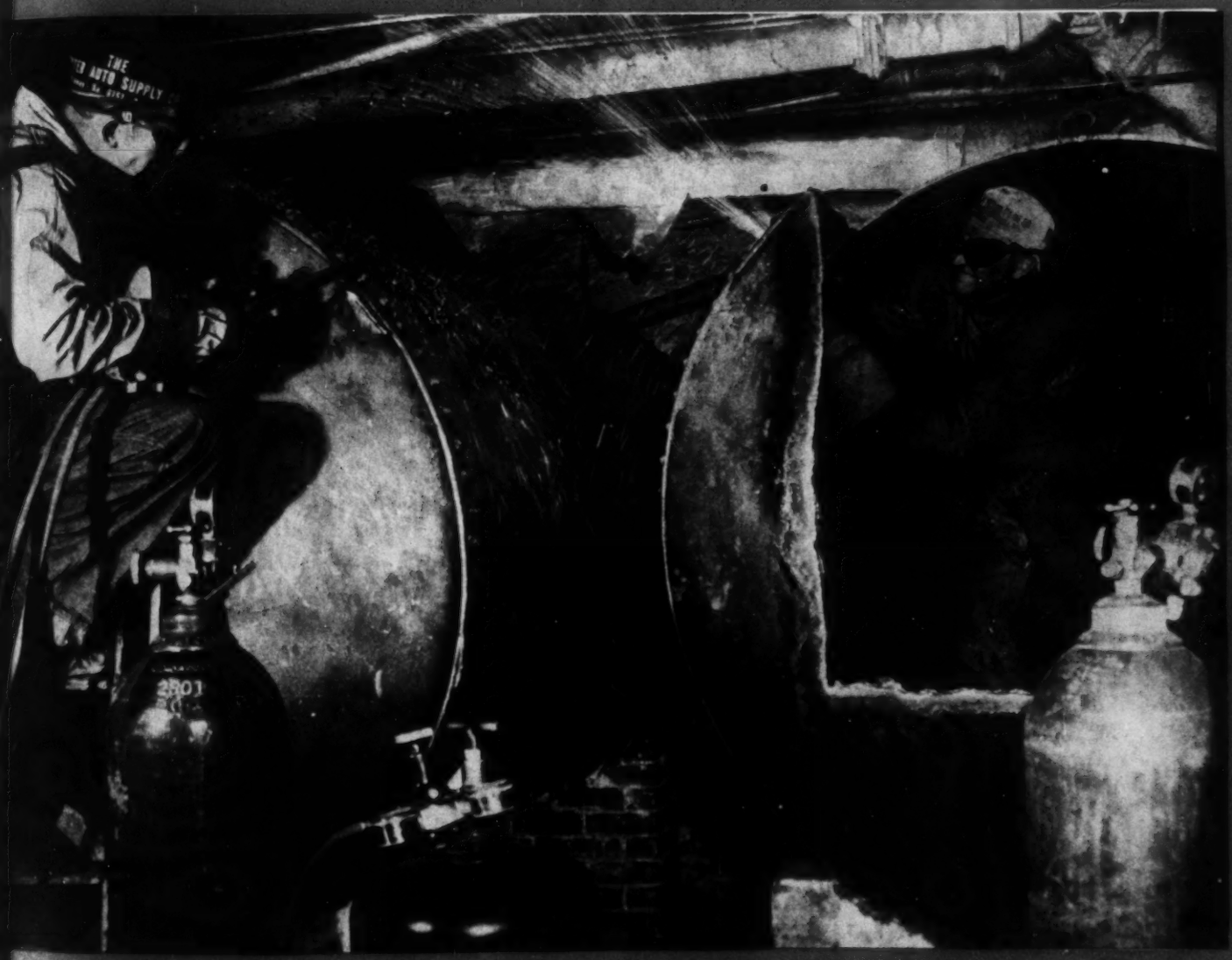
Heating Piping & Air Conditioning

DESIGN
INSTALLATION
OPERATION
MAINTENANCE

MARCH ★ 1943

INDUSTRIAL
COMMERCIAL
AND LARGE
BUILDINGS

141: Journal Section, American Society of Heating and Ventilating Engineers



If it hasn't been used for three months, and if someone can't prove that it's going to be used in the next three—sell it—or scrap it! (see p. 137)

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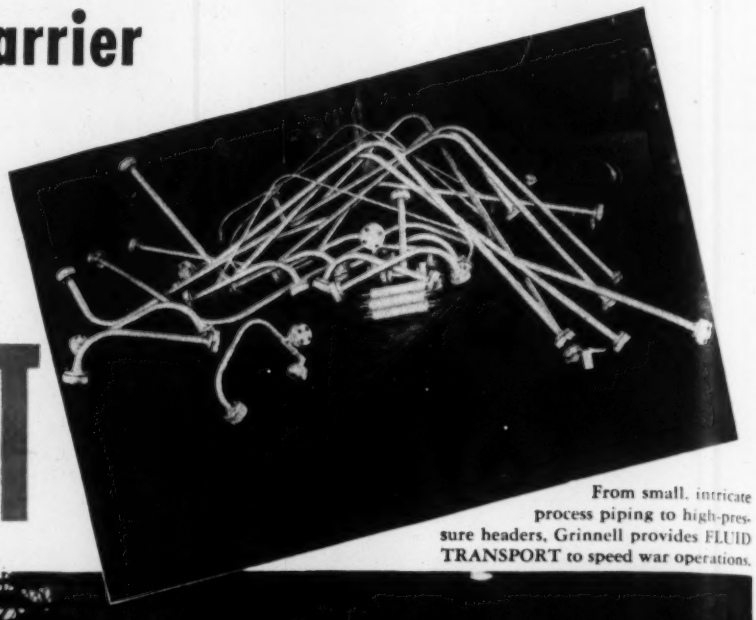
The Nation's 5th Carrier

FLUID TRANSPORT



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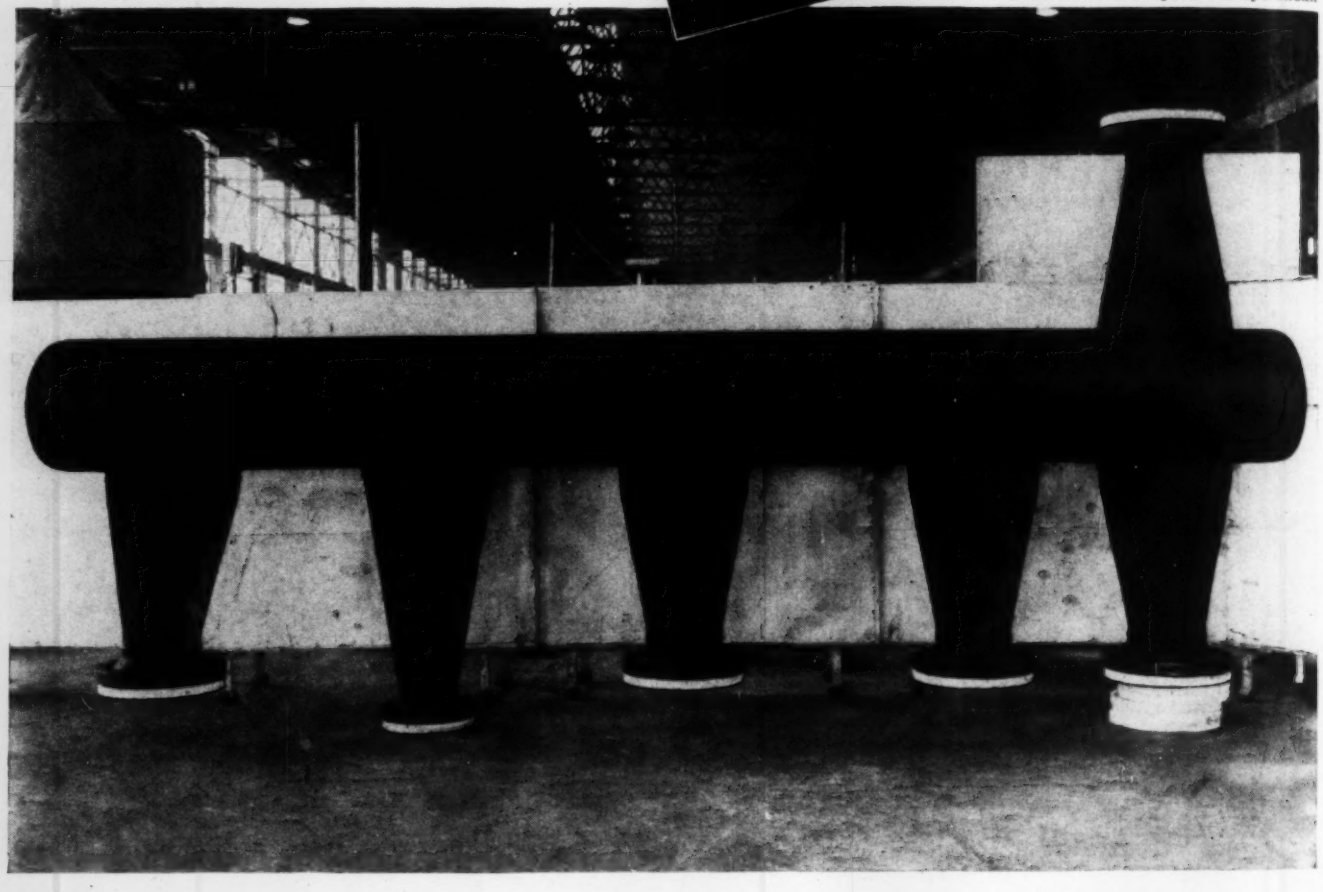

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WHENEVER **PIPING** IS INVOLVED

THE EDITOR'S PAGES

UNIVERSITY OF ILLINOIS MARKS 75TH YEAR

The University of Illinois celebrated its 75th anniversary March 2. In its 75 years of activity in education and research, one of the oldest and most outstanding achievements has been the cooperative research in heating, ventilating, and air conditioning. This has been carried on for 25 years. Of particular interest to the heating industry is the fact that the man who started this research at the university, Dr. Arthur Cutts Willard, is now president of the institution.

Study of heating problems at the U. of I. dates back even more than 25 years. A laboratory plant for testing furnaces was in existence there when the cooperative research began in 1918. According to Prof. A. P. Kratz, assistant to Dr. Willard when he started the work and now in charge of it, this plant represented the first successful attempt to test gravity furnaces under their own gravity head.

Results of the university's cooperative research in furnace heating have included the standard gravity code, a rating formula for gravity furnaces, and standardizing of furnace parts. Performance of forced air plants has been studied, and designs improved, including the finding that deflecting type grilles give better room temperature gradients.

Proof has been given of the saving from insulation and storm sash, and of the value of night setback of thermostats. Summer cooling studies have proved that forced air systems can be adapted for summer cooling, and that use of fans at night can improve comfort and supplement daytime artificial cooling.

In the field of ventilating, the outstanding work was perhaps Dr. Willard's studies on the plans for ventilating the Holland tunnel.

Research into problems of boiler and radiator heating has proved the value of one pipe forced circulation systems, of smaller radiators, of certain types of radiator shields, and of oil over metallic paints, and has shown the advisability of placing radiators under windows in exposed walls rather than against inside walls.

The effects of temperature, pressure, and humidity, and of radiation and air movement, upon the human body have been studied in a project carried on cooperatively by the colleges of engineering and medicine.

In the field of fuel burning, a downdraft conversion burner and a furnace incorporating the downdraft principle have been developed. These improve burning efficiency and overcome the smoke nuisance.

As a part of the nationwide wartime campaign to save fuel for victory, fuel saving suggestions, including use of insulation and proper hand firing methods, have been energetically taken to the public by radio, motion pictures, newspapers, magazines, and booklets and charts.

Also aiding the war effort has been the standardizing of furnace parts with a resultant saving of metal tied up in parts stocks. Engineers from the university have helped the Army solve heating problems involved in expansion of its camps.

To carry on the research, there have been erected in the university's mechanical engineering laboratory various test plants and booths, and a "cold room" in which any desired summer or winter temperature can be created and maintained at will around a typical room with two or three exposed walls of standard frame construction. The warm air research residence was built at the campus in 1924, and the IBR research home in 1941. Air conditioned rooms and wards have been installed at the college of medicine.

Anticipated postwar problems involve continued studies for improvement of equipment and practices, including the use and evaluation of new materials and processes developed during the war.

IRON AND STEEL QUOTAS FOR BOILERS

Quotas of iron and steel that may be used in the manufacture of low pressure cast iron boilers for war housing and civilian replacement needs, and in repair parts for such boilers, during the first six months of 1943, were increased February 13 with the issuance of an amendment of limitation order L-187 by the director general for operations of the War Production Board.

Because of abnormal seasonal requirements for repair parts, due in part to the reduced supply of new boilers and in part to conversions from oil and gas heating units to solid fuel burning types, the industry has been hampered in meeting the demand, both for parts and for completed boilers, under the quota previously in effect.

Manufacturers producing solid fuel burning boilers for civilian replacements and repairs are authorized under the amended order to use iron and steel during the first six months of 1943 in an amount equal to 13 per cent of the metal which they put into process in the fabrication of component parts of boilers during the calendar year 1940.

No restrictions are placed upon the use of iron and steel in the manufacture of parts designed for conversion of oil and gas low pressure boilers to coal burning equipment, or of repair parts for military or hospital low pressure cast iron boilers.

NEW BOOK ON AIR CONDITIONING PUBLISHED

William Goodman's new book on Air Conditioning Analysis is reviewed in the Useful Information department in this issue. However, because of the importance of this work and because Mr. Goodman, a member of HPAC's board of consulting & contributing editors, is so well known to readers of this page through his many articles in HPAC, it deserves also special mention here.

This book does an excellent job of making available in one place a comprehensive and unified treatment of the fundamentals of air conditioning. All who are concerned with air conditioning engineering, either for industrial or comfort work, will want to have a copy always at hand.

MAINTENANCE AND REPAIR ORDER L-41 AMENDED

A revised definition of what constitutes maintenance and repair of a building is contained in an amendment to the WPB's conservation order L-41, which was made effective last month. The new definition specifically designates that where a single job is partly maintenance and repair and partly new construction, the whole project will be considered new construction and subject to order L-41. In addition, the amendment reduces to $200 new construction which may be undertaken, without specific authority, by a number of manufacturing enterprises which are not essential to the war program. Moreover, the amendment applies to private dwellings and commercial structures.

Under the new definition, maintenance and repair means the work that is necessary to keep a structure in sound condition, but does not include any building operation involving a structural alteration or change in design.

In specifying industrial structures whose exemption under L-41 is reduced to $200, the amendment embraces all structures which have as their principal function the manufacture, processing, or assembling of any of the following: athletic supplies, sporting goods, toys or games; beverages (except milk); books, magazines, newspapers, greeting cards, or other printed or engraved matter; candy or chewing gum; jewelry, watches, traveling bags, brushes, razors, pipes and like articles for personal use or adornment; furniture, silverware, china, household electrical appliances, draperies, and all similar articles; musical instruments; sta-

THE EDITOR'S PAGES

Continued

tionery or office supplies; toiletries or cosmetic products, and all sorts of wearing apparel, except that for the Army or Navy. Any industrial construction with a productive floor area of less than 10,000 sq ft is also included. The amount of exemptions previously allowed these structures varied.

The order, as amended, provides that no construction may be begun or carried on unless it is specifically authorized by the War Production Board or unless the estimated cost of the project is limited to stated amounts. These amounts limit construction to $200 for residential and some specifically mentioned types; $1000 for multiple residential; $1000 for agricultural; $5000 for industrial; and $1000 for "other restricted" construction not otherwise classified. An additional exemption is allowed for construction which is necessary to restore or replace residential or multiple residential structures damaged or destroyed by disaster, provided that the estimated cost is less than $5000. In these cases, form PD-200 must be filed within two weeks after the damage or destruction occurs.

CHANGE IN P-126 ORDER SIMPLIFIES ADMINISTRATION

Under the terms of preference rating order P-126 as amended February 6 by the director general for operations of the WPB, a dealer engaged in emergency repair service of refrigerating and air conditioning systems may apply preference ratings assigned by the order if he holds a certificate of authority. The certificate, issued on form PD-472, is evidence that the dealer is operating as an "emergency service agency," as defined by the order.

This provision appeared in the original order issued in April, 1942, but P-126, as amended January 19, required the dealer to exhibit an unrevoked counterpart of the order as evidence that he qualified as an emergency service agency. The February 6 change was made to simplify the administration of the order.

REPAIR SERVICE FOR AIR CONDITIONING EQUIPMENT

Immediate action to safeguard essential refrigerating and air conditioning equipment against breakdown and to provide for quick repair service was recommended in a task committee report presented at a recent joint meeting of the advisory committee of the general refrigeration and air conditioning industry and the heavy machinery segment of the industrial refrigeration industry held in Washington.

The committee pointed out the importance of refrigerating and air conditioning equipment in food processing, transportation and storage, and in the production of many items directly needed for the war, including chemicals, explosives, and synthetic rubber. War production, it was recognized, will be retarded and serious loss in food supplies will occur if this equipment breaks down and cannot be quickly repaired. It is expected that the increased use of fresh food, due to restrictions on canned and processed food for home consumption, will make greater demands on transportation and storage refrigeration. Hence the refrigeration warehouses of the country must be kept in continuous operation.

The task committee, appointed to investigate repair and maintenance problems, based its conclusions largely on data secured from seven trade associations representing approximately 90 per cent of the industry. The findings show that there are serious delays in delivering repair parts because of difficulty in obtaining critical materials, and that there is already a serious shortage of skilled service and repair men. Among the recommendations made by the committee were the following:

1) Higher preference ratings should be granted for materials for emergency servicing of industrial and commercial refrigerating and air conditioning systems.

2) A supply of raw materials should be made available immediately for repair and replacement parts to take care of emergency breakdowns.

3) A plan should be worked out to provide against possible widespread breakdown of refrigeration equipment in a given area. (Measures to be taken in such an emergency should include the granting of priorities on the use of refrigerated space and transportation and on service and repair labor.)

Members of the task committee are A. B. Schellenberg, Alco Valve Co., F. S. McNeal, Universal Cooler Co., and M. G. Munce, York Ice Machinery Corp. The committee has been reappointed for a continued study of the problem.

ENDS RESTRICTIONS ON CORK INSULATION

The Armstrong Cork Co. announced last month that it has been advised by the War Production Board that all restrictions on the use of corkboard insulation have been removed.

Sloane C. Martin, manager of the industrial insulation department, stated that WPB order No. M-85 as amended February 20, permits cork to be used for roof insulation, for the insulation of air conditioning equipment, and all other nonwar purposes previously banned under the mandatory priority control placed in effect by the WPB in June, 1941.

Mr. Martin said that the new order does not end the allocation system but that monthly allocations of cork appear to be adequate for all military and civilian needs for corkboard insulation and for cork covering to be used on cold lines.

NAAFM BECOMES AIR FILTER INSTITUTE

The name of the National Association of Air Filter Manufacturers was changed to the Air Filter Institute at a recent meeting held in Chicago.

The officers of the institute are Charles G. Lamb, Detroit Air Filter Co., president; Cliff L. Rowley, Owens-Corning Fiberglas Corp., vice-president; and J. R. McConnell, American Air Filter Co., secretary-treasurer.

WHELLER NAMED PRESIDENT, MANAGER

Harry S. Wheller has been elected president and general manager of L. J. Wing Mfg. Co. Vice-president since 1917, he succeeds the late Alfred E. Seelig.

Other officers elected were Walter W. Wilson, who has been with the company over 30 years, as vice-president and treasurer, and Charles H. Smith, who has been with the company for 20 years, as secretary.

OUTPUT CHART KEEPS WAR WORKERS INFORMED

An output chart displayed in the lobby of the Marley Co. plant keeps workers informed of the results of their efforts, which are devoted 100 per cent to production for American and allied war plants and for Army and Navy bases.

That the patriotism of the individual workers is the major factor behind the company's increased output is proved by the fact that it has been accomplished with only slight increase in equipment and personnel.

ARMY ENGINEERS WELCOME CIVILIANS' SUGGESTIONS

The Army Engineer School, Fort Belvoir, Va., operates a suggestion system. Engineer soldiers are authorized to send suggestions direct without going through other military channels.

Civilians also are welcome to send suggestions. No useful idea is too small to report. Every idea is judged by competent critics. Every suggestion is copied and submitted to the critics without any indication of its source.

Heating Piping & Air Conditioning

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Design, Installation, Operation, and Maintenance

Industrial, Commercial, and Large Buildings

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Published monthly by the Keeney Publishing Co., 6 N. Michigan Ave., Chicago. Telephone: State 6916/ Subscriptions: U. S. and possessions, Canada, Mexico, Central America, South America, $2.00 per year; other, $4.00. Current copies, U. S. and possessions, 25c each, back copies 50c each. January, 1943, issue, $1.00 per copy/ Member of Audit Bureau of Circulations and the Associated Business Papers, Inc./

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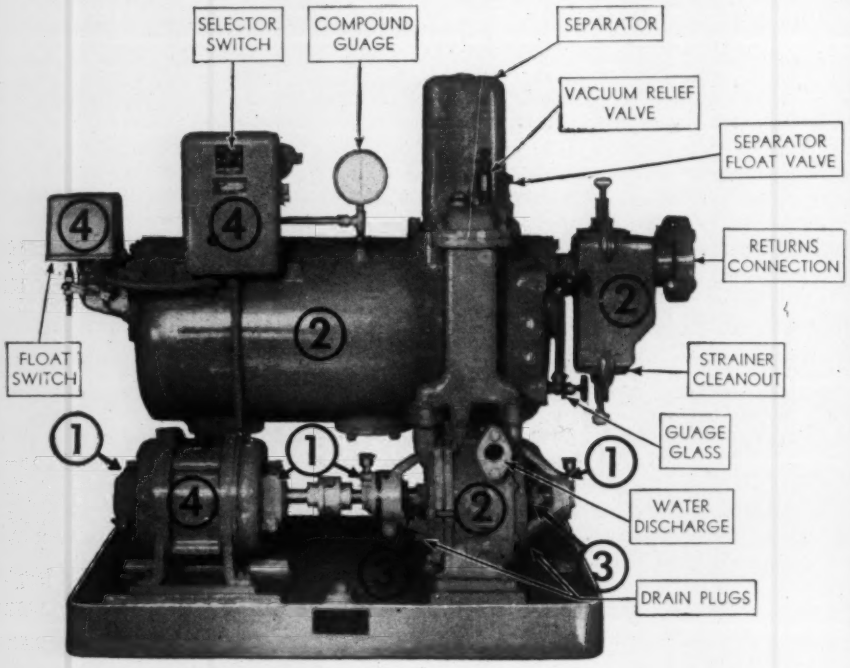
How to keep your Jennings Heating Pumps in First Class operating condition for Duration . . .



YOUR JENNINGS RETURN LINE VACUUM HEATING PUMPS

are an important part of plant or building equipment. They cannot be easily replaced and must last for a long time. Jennings Pumps are designed for long life, and have extra capacity which will count when it may be difficult to maintain lines and equipment free from leaks, but to give full service they must have proper care.

Now that these pumps have been in service all winter on the heating system, they should have a thorough inspection. Special attention should be given to the bearings, as no wearing contact occurs in a Jennings Pump as long as the ball bearings are properly maintained.

In most cases Jennings Pumps will require only the check-up we have recommended. If additional adjustments or repairs are found to be necessary, they should be undertaken at once. Do not wait until both time and materials are running short. Nash Service Branches are established throughout the United States. If you do not know the address of the one nearest to you, write directly to this office. Nash Service is yours to command, NOW.

SERVICE POINTERS

1 LUBRICATE PUMP AND MOTOR BEARINGS . . . Check bearings for end play, or radial play, and be sure they contain no grit, or foreign matter. If found to be clean and in good condition, fill with proper non-acid grease lubricant. If motor has oil lubricated bearings, flush out with fresh oil, and refill.

2 CLEAN STRAINER AND STRAINER SCREEN . . . Clean strainer well and strainer screen. If screen is found to be worn, and has passed foreign matter, thoroughly flush both receiving tank and pump casing. Drain plugs are conveniently located . . . Damaged screen should be repaired or replaced at once.

3 RENEW STUFFING BOX PACKING . . . Remove old packing and clean stuffing box. Fill with new loose-woven graphite-impregnated stuffing box packing, in individual rings. Be sure joints are staggered, and that ends butt properly without over-lapping. Do not finally tighten gland until pump is again in operation.

4 HAVE MOTOR AND CONTROL INSPECTED . . . Have an experienced electrical service man go carefully over motor and control. Follow his recommendations and if repairs or replacements are indicated, have the work done immediately.

5 CHECK OPERATOR'S INSTRUCTION BOOK . . . If operating instructions originally furnished with the pumps have been lost, write to us at once for a new copy for each pump. BE SURE TO FURNISH US THE TEST NUMBER OF EACH PUMP, as stamped on the pump name plate.

6 IF PUMPS REQUIRE REPAIRS . . . and you do not know the address of our nearest Service Branch, notify us at once, and we will have our Service Engineer get in touch with you without delay . . . There are well equipped Nash Service Branches in most principal cities, ready to give you every possible help.

NASH ENGINEERING COMPANY

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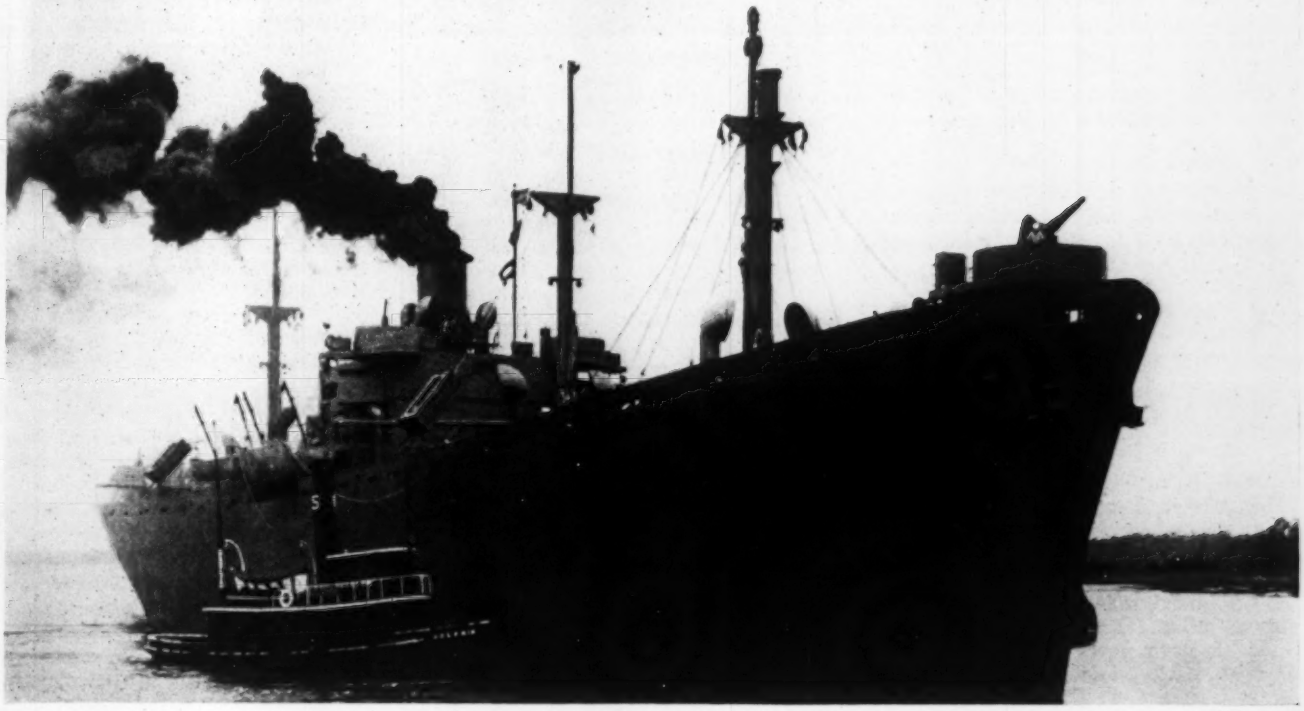
HEATING THE "Ships for Victory"



U. S. Maritime Commission photo

John Clarke, Senior Marine Engineer, U. S. Maritime Commission, Explains Ship Heating Requirements of Vast War Building Program

SUMMARY—Cargo ship construction is one of the vital elements of our national war effort. To meet the demands of victory, all-out ship production is required, and many engineers, contractors and suppliers are now engaged in marine design and construction whose previous experience has been largely with land installations. . . . Mr. Clarke—head of the heating, ventilating, and refrigeration unit of the engineering plan approval section, Great Lakes regional office of the U. S. Maritime Commission—explains the requirements of marine heating installations, design temperatures and heating calculations, ship heating services and control, and gives information on proper submittal of plans for government work. . . . In future articles, he will cover design and installation of the heating system piping, equipment design, hot water heating systems, valves, fittings, insulation, etc. . . . His material pertains primarily to cargo ships, and where Navy or Army work is concerned the designer should be particularly careful to familiarize himself with the special standards and requirements of the armed services

THE DESIGN of a marine heating installation presents no problems that are more difficult than those encountered ashore. The essential thing is that the designer recognize the problem for what it is, and attack it accordingly. It is because Henry Kaiser has recognized this principle that he has been such a success in shipbuilding. He did not originate prefabrication. Several shipyards have been prefabricating for at least five or six years. But Kaiser and his engineers were smart enough to study the methods and specific requirements of shipbuilding, and of his task in particular. Having done this, they simply went ahead on a more extensive and elaborate scale and are doing the job better than anyone else has been able to do it.

Attention is called to this because so many land heating designers and contractors who are now engaged in shipwork are still going forward on the assumption that the rule of thumb methods and design data that they have been following in the past still hold for ship work. Excepting the more fundamental principles, they certainly do not. Why? Simply because the operating and installation conditions are entirely different. Let us consider a few of the things that should be kept in mind.

Marine Requirements

1) The installation should be as light as practicable. Excess weight reduces the cargo carrying capacity and affects the stability of the ship.

2) The installation must be compact. Rooms and machinery spaces are small, ceiling heights are low, and space in general is at a premium. Equipment space must be taken from the revenue earning volume of the ship.

3) All equipment must be well protected from the corrosive action of the salt air. In no case should this factor be underestimated.

4) The watertight and fire resistant integrity of the structure must be

maintained. Cutting or piercing of this structure must be kept to a minimum.

5) The equipment must be designed to operate properly and without damage under conditions of rolling, pitching, and permanent list. The specifications define the design conditions as 30 deg for rolling, 5 deg for fore and aft pitch, and 15 deg for permanent list. A ship rolls about twice as much as it pitches. In order to minimize bearing wear caused by gyroscopic action, all rotating equipment, including fans and pumps, should be installed with the axes fore and aft.

6) Where the equipment is exposed to the weather, or to loading or cargo stowage operations, it must be strong enough to hold up without damage or must be adequately protected from damage.

7) The operating crews must be trained as all-round operating engineers—with the emphasis on the propulsion equipment. They shouldn't be expected to be experts in heating and ventilating, so the equipment must be designed to operate with a minimum of care and attention.

8) A ship is and must be a complete and self reliant freight, hotel, and power unit. It may be away from home port for months at a time and all equipment must be designed with this in mind. For the same reason adequate spare parts must be provided so that damaged, defective, or worn parts may be replaced and the various systems kept in operation at sea or in port. Spare equipment must be provided in some cases for the same reasons.

9) In the travels of the ship, climate changes are frequent, rapid, and extensive. Also, a ship designed for one trade route may be transferred to another route. Thus, all equipment must be versatile enough to maintain the desired conditions under these circumstances.

Design Temperatures and Heating Calculations

In calculating the heat loads for a ship it should be kept in mind that the outside temperatures at sea are never extreme, either high or low. The lowest temperatures that will be encountered will be the port temperatures. It is estimated that 90 per cent of the heating season the outside temperature will not be less than 30 F. The usual low temperatures will run around 15 F. Temperatures of 0 F and below will be encountered very few times and only for short duration. Ordinarily a ship may operate on any number of trade routes, and with this in mind, and considering all other factors involved, the usual outside air design temperature is 0 F. For small auxiliary boats and tugs which are not apt to be moved out of the vicinity, it is recommended that the base design temperature for the vicinity (as given in the ASHVE Guide) be used.

The inside design temperatures should be about 70 F for living spaces; 60 F to 65 F for working spaces, depending upon the type of activity; and 50 F in the steering gear room, if heated. Toilet and washroom spaces are usually heated to the same temperatures as the staterooms.

The heat loads are calculated using the same methods and heat transfer coefficients as outlined in the ASHVE Guide. There are some differences, however, which should be noted:

1) Generally speaking, there is no such thing as infiltration on the average cargo ship. The structure is watertight and, consequently, airtight. Exceptions to this will be found in non-sea going boats such as tugs, and particularly wooden tugs. But even here, any allowance for infiltration should be made only where it is known to exist. However, unheated ventilation air must be considered in the heat load.

2) In a similar manner, no allowance is made for variation of exposure.

3) No factor of safety should be added to the calculations, except for the pilot house, and where equipment capacities will be reduced by fouling or corrosion. The base temperature of 0 F represents in itself a factor of safety of over 25 per cent while in port, except where extremely low port temperatures are known to exist. In this case, the base temperature should be lowered to the recommended design temperature for the location. It should be kept in mind that any ship heating system can be "stretched" for the duration of unusually low temperatures, either by increasing the fan speed, by increasing the steam pressure, or both.

4) In the pilot house a considerable allowance must be made for the fact that it is often necessary to navigate in cold weather with the pilot house windows and doors open. It is suggested that 25 to 50 per cent be added to the calculations to take care of this. In many cases, the installed radiation will be limited by the space available. There has been no consistency in providing heat for this space. The heat provided on small tugs has been about 10,000 to 15,000 Btu (two radiators); Great Lakes ore carriers, 42,000 Btu (six radiators); sea going tugs, 35,000 Btu (two radiators); C1, C2 or C3 cargo ships, anywhere from 20,000 to 35,000 Btu (two radiators).

5) For those not familiar with ship heat transfer coefficients, the commonly used coefficients of Table 1 are offered for guidance.

Other structure which is insulated would be calculated in the usual manner, using an inside surface coefficient of 1.6 and an outside surface coefficient of 6.0.

Steam and Drain Systems

Steamships

On steamships the heating steam is generally taken from some auxiliary line—usually at 125 to 150 psi—and reduced to 15, 20, 30, or 35 psi gage. In the few cases where cast iron radiation is installed the pressure should not be more than 15 psi. Otherwise, it is believed that the 35 psi represents the best pressure. At this pressure, the weights and sizes of the equipment and piping are considerably reduced, and at the same time, this pressure does not exceed the allowable working pressure of any of the equipment. For these reasons, plus the fact that manufacturers are now accustomed to designing for this pressure, the Navy and Maritime Commission specify 35 psi gage for their heating systems.

The drains for the system should be led back to an atmospheric drain tank, and from there go to the condensate system direct or to the deaerating heater if such is provided. Either a pump or return trap should be provided for pumping to the deaerating heater. In no case should the drains go to the deaerating heater direct, because it is situated high in the machinery space and the back pressure (10 psi gage) would flood the heating units. Draining to any container under a vacuum should also be avoided. Because of the high pressure steam, there is a considerable amount of flashing in the condensate lines and to drain to a vacuum would considerably aggravate the problem.

Diesel Ships

On large diesel ships the steam is taken from a waste heat boiler, which is supplemented by an oil fired section. The pressure in the boiler is usually 50, 75, or 100 psi gage, so the steam pressure should be reduced for the heating system. On small boats the waste heat boiler presents quite a problem in disposing of the excess heat and steam, and a separate oil fired unit is all that is provided. However, in picking the boiler the designer should be careful to pick a unit suitable for the installation. Inherently,

Table 1—Ship heat transfer coefficients (Btu per hr per sq ft per F)

Shell plating (below water) painted only	1.30
Shell plating (below water) cork painted	1.06
Shell plating, etc., (above water) painted only	1.30
Shell plating, etc., (above water) cork painted	1.06
Bulkheads inside (air both sides) painted	0.70
Bulkheads inside (air both sides) cork painted	0.63
Bulkheads (air one side, water on other, beams or stiffeners on tank side) painted	1.36
Bulkheads (air one side, water on other, beams or stiffeners on tank side) cork painted	1.08
Bulkheads (air one side, water on other, beams or stiffeners on air side) painted	1.08
Bulkheads (air one side, water on other, beams or stiffeners on air side) cork painted	0.91

the scotch return tube type of boiler is unsuited for marine installations. Cast iron heating boilers are likewise unsuited, and could not be used for pressures in excess of 15 psi gage because of the United States Coast Guard, Division of Marine Inspection and Navigation, rules.

There are a number of boilers available which are particularly well designed for marine installations. These include several efficient vertical fire tube boilers, a number of compactly designed water tube boilers, and at least two forced circulating coil type steam boilers. The latter are particularly advantageous in the larger capacities (800 to 5000 lb per hr) because of their light weight and compactness.

In selecting a boiler it should be kept in mind that cost and weight are important, and that the cubic and floor area required by the unit are particularly important. In sizing the boiler, keep in mind that it is a marine unit and restrict the reserve capacity to a reasonable figure—not more than 25 per cent in any case. This safety factor should not be over and above the factor added by the boiler manufacturer. With few exceptions a ship is heated up continually during the heating season. Further, the piping radiation losses actually contribute to the heating of the ship. Consequently, no allowance need be made for these items.

The boilers should be provided with the usual stack switches, relief valves, low water cutoffs, etc., to protect them against damage. Low water cutoffs should be used with caution. Where installed they should be placed so as to operate from the fore or aft end of the boiler (because of the rolling of the ship) and should be provided with a *manual* reset only. Electric burner starters should be designed for the available power supply, which is usually direct current. Converters, or slip rings on the burner motor, may be used for starting.

In all cases where the boiler pressure is over 15 psi gage it must be kept in mind that the boiler must be approved by the United States Coast Guard, Division of Marine Inspection and Navigation, unless it is being provided for and approved by the Navy or Army.

The drain systems for the diesel ships should be similar to the system described for the steamships, in that the drains should be led to an atmospheric drain tank and thence pumped to the boiler. This is the most desirable system also for the small boats using individual heating boilers. The use of gravity drains is not recommended because it brings up difficulties in drainage and trapping, and most of all requires relatively large piping. Rather than use a gravity return system, it is believed that a forced circulation, high temperature, one pipe, hot water heating system would be more desirable.

SUBMITTAL OF PLANS FOR GOVERNMENT WORK

In submitting plans for government work, and particularly for ship design, it should be kept in mind that complete information is necessary not only as a matter of public record, but also because this information is used extensively as reference material for duplicate ships and future design. For this reason, the information contained therein should be complete with respect to all pertinent information. The following is offered in order to expedite approval of the plans, and to avoid unnecessary resubmittals which cost money, waste the time of all concerned, and may ultimately delay the ship construction:

1) All drawings or sales data sheets submitted for approval should be provided with a title which is indicative of the items submitted, and a drawing or identification number. This material must be given a government reference number and properly filed by a file clerk who is neither an engineer nor expected to be one. If the proper information is not given, the drawing may easily be misfiled, lost, or otherwise become the cause of delay and confusion.

2) Arrangement and sectional plans of equipment should contain all pertinent data on dimensions, capacity, power, current, temperatures, pressures, rpm, relief valve settings, etc. A bill of material should be provided, listing the parts and identifying them by number or otherwise, and giving the material, thickness, and finish of each part unless this information is already included on the drawing. A complete set of notes should be included which will indicate the type of connections, shop and installation tests, and any other similar conditions of the design. All of the above will not be necessary on the detail plans of equipment, and very little is required for outline drawings, which are primarily used for installation purposes and should, therefore, include the overall dimensions. When in doubt, include the information. It is important that types of connections and protective coatings should be indicated. And in all of the above, be specific. Do not state that a "rust resistant coating is provided." Indicate "hot dipped galvanizing *after fabrication*," "parkerizing," "bonderizing," etc.

3) Plans or information should be provided for all equipment. Equipment of lesser importance such as thermometers, gages, domestic water heaters, air heaters, relief valves (not on power equipment), control valves, etc., may be submitted for approval by means of sales data sheets or type prints. However, pertinent information must be included on, or marked on, these data sheets. Where alternate material, sizes, etc., are shown, indicate clearly which is being submitted for the installation. It will not be necessary to change original drawings or data sheets if the necessary data to be added are marked in indelible or other permanent method. Type blueprints can be marked with bleaching ink. All such markings should be clear and legible.

4) Where plans show views of the ship, locate and identify the compartments shown. Where pertinent, give the compartment volumes, and identify the frame numbers, and sections and elevations.

5) With very few exceptions, ordinary solder (50-50, 95-5, etc.) is not permitted in ship work for piping equipment and similar connections and should not be used without specific approval, except in places such as where copper fins are bonded to copper tubes (as for radiators and air heaters) and consequently where the tightness and integrity of the piping system is not affected. Otherwise, sweated joints should be made up with silver brazing alloy and this should be so noted on the drawings.

The above cannot contain all the facts that should apply to a given case, but a little thought on the subject should make it apparent to the manufacturer, contractor, designer, or engineer what data he should consider for his particular plans. A little time expended at the source can save weeks in clearing the data so that the work may proceed.

Heating Services

Ship's Heating

Heating should be provided for all living spaces, such as staterooms, toilet spaces, washrooms, lounges, messrooms, offices, working spaces, and the pilot house. Heat is also provided in some spaces where it is desirable to keep the electrical equipment dry, and in steering gear rooms where electro-hydraulic steering engines are used, so as to keep the hydraulic equipment warm and operating freely. Heat is very seldom provided in the ship's dry stores and linen spaces, and is never provided in the galley. Neither is heat required in small stateroom washrooms and toilets that are entirely surrounded by heated spaces.

The engine rooms on diesel ships are provided with some heat for convenience when the main engines are shut down. Steering gear and engine rooms, and quite often the working spaces, are heated by propeller type, blow through unit heaters. The heat provided in the steering gear and engine rooms is in the nature of "spot" heating and it is not necessary to heat the whole space. This should be kept in mind in making the calculations. On the usual cargo ship the steering gear room would be well heated by two unit heaters with a total capacity of about 100,000 to 125,000 Btu. The unit heaters for the steering gear room should be situated at the aft end of the space and blow forward onto the equipment.

In the engine room of a cargo ship, four unit heaters with a total capacity of about 150,000 to 200,000 Btu should be sufficient. In harbor tugs one or two unit heaters in the engine room, with a total capacity of about 30,000 Btu, should be provided. The engine room unit heaters should not be placed so as to oppose each other, but rather to induce a rotational air movement in the space.

Domestic Requirements

The heating system on the ship should not only provide heat for the quarters, but it should provide heat or steam to all services requiring steam and not supplied by the main power plant auxiliary steam lines. This includes all heating for domestic water, galley equipment, laundry dryers or presses, or any similar equipment. On diesel ships it may be necessary to provide steam to the sea chests to keep them clear of ice and debris.

The usual galley equipment provided on cargo ships is as follows (steam load given in lb per min):

Item	Load
One 25 gal steam kettle.....	0.9
Two 6 ft steam tables.....	0.6 (each)
Two 5 gal coffee urns	0.3 (each)

The domestic hot water requirements are generally furnished the heating designer but several items should be noted: Where separate washing water and potable water systems are installed on the ship, a separate water heater should be provided for the galley so that potable hot water will be available for washing dishes and preparing food. The United States Public Health Service recommends a separate water heater for the galley in any case because the usual hot water temperatures run from 125 to 150 F, and it is thought that galley hot water should be at least 180 F to provide sanitary conditions.

In figuring the boiler load for the above equipment it should be carefully factored, considering the peak conditions and the usage. A reasonable factor would be 25 per cent of the galley load and 25 per cent of the domestic water load. No load should be added for steaming out sea chests, tanks, etc., where the load is of very short duration. In sizing the piping for all of this equipment, the full load for each unit should be considered for the branch piping. The steam main can be sized on the basis of a factored usage load.

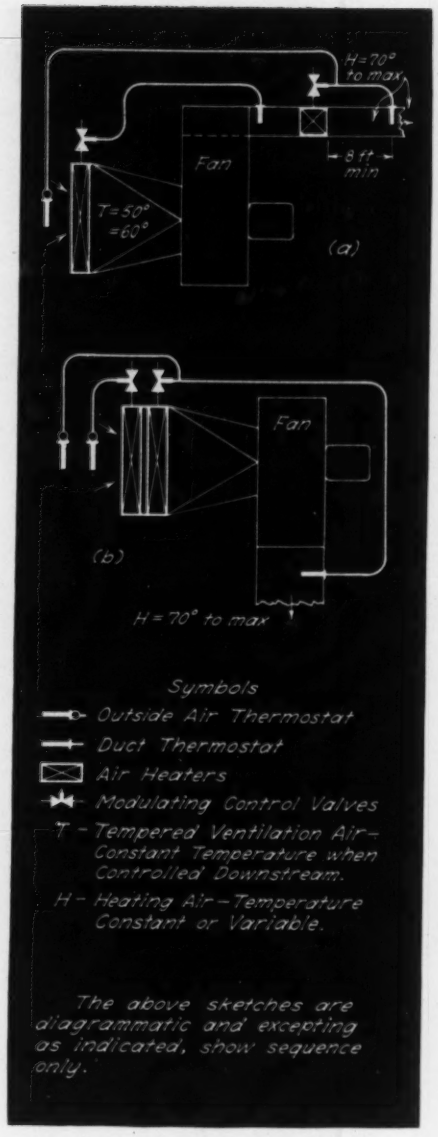


Fig. 1a (above)—Zone reheaters are controlled by duct and outside compensating thermostats . . . Fig. 1b (below)—In some cases it is necessary to design a zoned system with both preheater and reheater ahead of the fan. This should be avoided if possible

Heating Systems for Quarters

In general there are three types of systems used, a zoned ventilation heating system, a unit ventilation heating system, and a split system.

A) In the zoned ventilation system the air is preheated to 60 F and reheated by zoned reheaters to the final temperature necessary for heating. On cargo ships, where this system has frequently been used, zone reheaters are situated on the bridge deck, and port and starboard on the lower decks. Where there is a large space such as a messroom or crew's quarters space, it is usually best to heat with room type heaters controlled by a thermostatic valve and room thermostat. The zone reheaters are controlled by duct and outside compensating thermostats as shown in Fig. 1a.

In designing any ventilation heating system it will be necessary to base the heating on reduced fan speed (50 per cent is usually specified) so as to keep the final air temperature high enough to avoid a cooling sensation and, incidentally, to effect a material saving in heat. In addition, with a zoned system it is absolutely essential to balance the system for heating. To do this, the nominal amount of ventilation air to be provided for each space should be decided upon. The volumes to the individual rooms will then have to be adjusted in proportion to the heat requirements. A final check will have to be made to be sure that summer ventilation requirements will be fully satisfied at full fan capacity. Where any space is considerably out of line with the other spaces in the zone, it may be necessary to provide an individual heater to the space, or to rezone the ship. The designer is cautioned, however, against using individual room heaters in spaces of low heat loss because it is very difficult to obtain proper steam control.

B) The unit ventilation system, in which individual air heaters are provided for each space, is seldom used in cargo ships because of the above mentioned difficulty in controlling steam at the low capacities. Its main use now is in conjunction with a zoned system. In such a case it is used for all large spaces having high heat losses, and in which individual heaters would be indicated thereby. It is particularly desirable to provide such heaters for large messrooms or dining saloons because the heating requirements vary too widely to permit them to be heated properly by the "average" air temperature of a zoned system. A unit system in which ventilation air was to be delivered to room type unit heaters (and coolers) provided with recirculating fans, was proposed for some of the passenger cargo ships building prior to the war. Water was to be the heating and

cooling medium. The proposal was abandoned because of the urgency of completing the vessels for war use.

C) In the split system the heating is provided by radiators (usually convectors) and ventilation air is provided either naturally or mechanically. On the Liberty ships and many of the emergency ships where radiator heating is used, natural ventilation only is provided. On the usual cargo ship the ventilation is provided mechanically and the air is preheated to about 70 F.

The split system is more expensive than the zoned system (if mechanical ventilation and tempered air are provided for the latter) but it is more foolproof in operation as far as individual heating requirements are concerned. It does, however, require more piping and valves, and thus requires considerable maintenance.

D) There is one other system that should be mentioned in passing, and that is the "dual duct" system, in which parallel ducts (one hot and one cold) are led to mixing dampers at each outlet. This system has been used on a number of passenger ships. Experience in this respect has proved that it is difficult and expensive to install, and since it does not provide automatic control of room temperature, the extra expense is not warranted. In addition there are numerous difficulties involved in maintaining the proper duct temperatures and pressures. It is the opinion of the writer, as well as of several other marine engineers, that the dual duct system has no place in marine work.

Location and Control of Heaters

The air heaters, and the fan assembly and the piping to and from the heaters, should be within the deckhouses, and not exposed to the weather. This protects the intake system from soot, sleet, and snow, and keeps the piping system from freezing. All preheaters should be ahead of the fans so as to provide the best condition for control (thermostat in fan outlet) and the reheaters should be preferably in the fan room to keep them out of the passageways and quarters. In some cases it may be necessary to place the heaters in the machinery casing, but if this is done the duct work should be heavily insulated to prevent heat pickup during summer ventilation. Where individual heaters are provided for a space it is best to place them elsewhere (in a service space, passageway, or other convenient location); otherwise the heater will create quite a problem in headroom.

The control thermostats should be carefully situated for the best results. Fig. 1a shows the preferred location of the heaters and thermostats. The preheater thermostat after the fan should be set at about 60 F. For a zone reheater the duct temperature is controlled by an outside compensating thermostat (at the intake to the ventilation system) which is set to raise the duct temperature from 70 F to the calculated maximum as the outside temperature drops from 70 to 0 F. A duct thermostat is also provided in conjunction with the outside thermostats to maintain the temperature as it is reset, in case of any change in the steam pressure, etc. The duct thermostat must be well down the duct so as to prevent its being acted upon by stratified air. If this is not possible, then an averaging thermostat or baffle (to provide turbulence ahead of the thermostat) must be provided.

In some cases it may be necessary to design a zoned system with both the preheater and reheater ahead of the fan as in Fig. 1b. This should be avoided if at all possible, but where such is the case, the preheater thermostat should be in the air intake and set so that as the outside air drops from 60 to 0 F, the duct temperature will be kept at approximately 55 to 60 F. The reheater thermostats would be set and situated as for the reheater of Fig. 1a, except that the duct thermostat could be following the fan. Where the heaters of Fig. 1b are a few feet apart, the preheater thermostat must still be in the outside air. If the thermostat were between the heaters it would then be impossible to avoid the effects of radiation and air stratification.

In no case should a zoned ventilation heating system, or any heating system, be controlled by a room type thermostat which is so placed as to be acted on by the temperature of an "average" space, or by exhaust air through a passageway. There are too many conditions prevailing on shipboard which preclude proper operation of such a control.

RATIONING FUEL OIL FOR COMMERCIAL BUILDINGS

THE EDITOR—

Thank you for the advance proof of the article Rationing Fuel Oil for Commercial Buildings, by Lewis W. Mauger (published in the February HPAC). I find it of considerable interest.

I think perhaps you will be interested in some of the reasons for the present method of ration determination for commercial buildings. I am listing some of those reasons, not necessarily in the order of their importance:

1) A wide divergence of opinion among qualified heating engineers on the method of ration determination (for example, cubic content, standing radiation, pounds of steam per cubic foot per degree day, floor area, etc.).

2) Extreme variation of heat requirements within one building (for example, usage within one building might vary from medical examination rooms to unused storage space).

3) Variation of heat requirements for buildings of similar construction in the same geographical vicinity.

4) Lack of zone heating controls in a large percentage of commercial buildings.

5) Necessity for reasonably simplified plan of ration determination by local boards.

6) Extremely critical fuel oil shortage (principally transportation shortage plus increased demands of armed forces) make conversions for commercial buildings mandatory.

I shall of course, continue to welcome any and all suggestions for the improvement of the fuel oil rationing plan. I feel that it would be a genuine contribution if, through your publication, you would secure a digest of ideas and suggestions from qualified heating engineers. You may be sure that full consideration would be given such information.—JOEL DEAN, director, fuel rationing division, Office of Price Administration.

CONVERSION COST YARDSTICK FOR OIL FIRED PLANTS

THE EDITOR—

We wish to thank you very much for the advance proof of the article on fuel oil rationing.

We note that you use a yardstick of 5c per gal of fuel oil consumption to determine whether or not the cost of conversion is reasonable. It is our opinion that this might be misinterpreted, as there are plenty of jobs that may have to be converted, the cost of which will exceed this figure.

It is our feeling that your article in general gives a very good picture of the oil situation.—JOSEPH F. WILBER, director, plumbing and heating division, War Production Board.

"OPEN FOR DISCUSSION"

Ventilation for Control of Solvent Exposures in

Fabricating Rubber Military Equipment

By T. R. Thomas and B. D. Tebbens

SUMMARY—Fabrication of five types of rubber military equipment was found to require large amounts of solvents, both toxic and relatively innocuous. In making rubbercoated fabrics, balloons, airplane fuel tanks, rubber boats, and pontoons, a large and increasing number of persons are exposed to solvent vapors, the more toxic aromatic and chlorinated solvents being used with synthetic rubber. . . . An engineering study was made of the existing exposures, and of control measures installed or planned to alleviate the hazards. The more effective methods are explained in the detailed study. . . . A section on control of potential hazards of handling acrylonitrile in production of synthetic rubber is included also. . . . The authors are, respectively, P. A. Sanitary Engineer (R), and P. A. Industrial Hygiene Engineer (R), Division of Industrial Hygiene, National Institute of Health, U. S. Public Health Service

SOLVENTS, BOTH toxic and relatively innocuous, have assumed a major position in the hygiene problems of the rubber fabrication industry. Benzol and its homologues, as well as the chlorinated solvents, carbon tetrachloride, and ethylene dichloride, are necessary solvents for the greatly increased amount of synthetic rubber now in use, since petroleum naphthas will not adequately dissolve these materials. (1)* War production of important military equipment has increased greatly the number of persons handling the solvents, including many women recently brought into the factories.

Following a conference on May 29, 1942, concerning health hazards in the rubber industry, the Division of Industrial Hygiene, National Institute of Health, U. S. Public Health Service, undertook this study of the control of potential exposure to solvent vapors. The original health conference was inspired by the occurrence of disabilities and deaths from inhalation of benzol. Solvents in question, besides those mentioned above, were carbon disulfide, petroleum naphthas, and ketones. It was felt that some information was desirable on control measures at operations where the less toxic solvents are now used, since synthetic rubber may later replace the natural product with the attendant increased danger from toxic solvents used with synthetic rubber.

Although the production of synthetic rubber does not require organic solvents, one of its raw materials, acrylonitrile, has been found to be a severe poison (2, 8), so its use was investigated in connection with this study. A broader study of the use of benzol and other solvents in industry is being carried on and is to be reported later.

*Numbers in parentheses identify the references at the end of this article.

Scope of Study

After a reconnaisance survey in four fabricating plants, the following types of manufacture were found to be those in which solvent hazards existed, either actually or potentially, for a large number of persons: (1) Fabric coating. (2) Balloon fabrication. (3) Airplane fuel tank fabrication. (4) Rubber boat and pontoon fabrication. (5) Synthetic rubber production.

These five types of work were then studied in detail by analyzing the manufacturing procedures, obtaining air samples where possible for quantitation of existing exposures, reviewing the proposed or existing control measures, and measuring the air flow of ventilating systems. Although complete information was not available in all the above categories, the collected data are included in this report. Observations of typical control measures are outlined, and those installations which appeared to be particularly effective are presented in detail.

Use of Solvents

Procedures briefly outlined in the following paragraphs are explained more fully in the subsequent text. Fabric was coated with natural or synthetic rubber by spreading a thin layer of the material, suspended in a suitable solvent, onto moving cloth from behind a spreader blade. The vehicle was then evaporated from the fabric by heat, leaving the rubber impregnated in and on the surface of the cloth. Gas containing cells such as balloons, rubber boats, and pontoons were then fabricated from this material by cementing together sections of the fabric previously cut to pattern; for this work, a cement consisting of rubber dispersed in a suitable medium was used. Finally, a rubber reinforcing tape was cemented over the seam. In addition to the cement vehicle, organic solvents were used for washing dirt from the fabric and for softening some surfaces in preparation for cementing (tackifying).

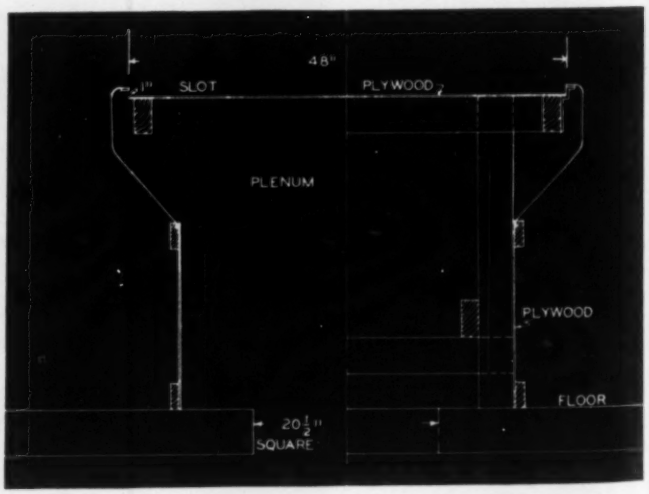
Motor fuel tanks were fabricated by cementing together over a form several layers of sheet rubber or heavily impregnated fabric. Solvents were used as vehicles in the rubber cements as well as for washes and tackifiers. These adhesives were used to cement together the various layers, to make the necessary seams, and to insert edge reinforcements and such appurtenances as hose connections and cleanout ports.

Synthetic rubber of the buna N type is a copolymer of butadiene and acrylonitrile. While no organic solvents are required for this production, the acrylonitrile is a serious potential hazard, and its safe handling will be considered.

Determining Vapor Concentrations

For determination of vapor concentrations of the coal tar solvents and of toluene-petroleum mixtures, such as those from processed petroleum trade name solvents, two methods were used: the Mine Safety Appliances Co. benzol indicator, and the spectrographic method developed in the National Institute of Health (3). The second technique was used to check the indicator which proved to be sufficiently accurate for both benzol and toluol. Atmospheric concen-

Fig. 1—Section on lateral ventilated table. Air flow = 50 cfm per sq ft of table surface



trations of petroleum naphthas and of ketones were not determined.

The chlorinated solvents, ethylene dichloride and carbon tetrachloride, were sampled by two methods to obtain some data on the correlation of a new method being developed in the National Institute of Health with one of proved efficiency. The latter was the method of Elkins (4), using amyl acetate as an absorbing medium. In comparable samples, agreement between the two methods was good.

Carbon disulfide was determined in one location by bottle absorption in the triethanolamine-copper acetate reagent suggested by Viles (5) and modified by McKee (6). Since no adequate method existed for determination of acrylonitrile, no samples of this vapor were taken. Other laboratories are now working on this determination.

Determinations of air flow were made with the swinging vane, direct reading, velocity meter and its several attachments. Ventilation measurements were supplemented by information from the several engineers and consultants responsible for planning and installing the systems.

Fabric Coating

Solvents used for this work varied considerably, depending on the nature of the rubber coating. For natural rubber, petroleum naphthas were used almost without exception, some toluene being incorporated in occasional formulas. Coatings of synthetic rubbers, however, required solution in the more toxic solvents. At the present time, benzol has been replaced largely by toluol or tradename processed petroleums which contain a large proportion of toluol. Some synthetic rubber coating mixtures were diluted with small amounts of petroleum naphthas. Although the chlorinated compounds previously mentioned are solvents for synthetic rubbers, these materials were not encountered in fabric coating departments.

The dispersed rubber was spread on strips of fabric on a standard coating machine. In some plants the rubber suspension was fed to the doctor blade by hand from a pail, while in other installations lines were used. At the doctor blade a controlled thin coating was spread on the fabric, which then passed over heated coils to evaporate the solvent before the fabric was rewound. The drying time depended on the type of solvent used.

The obvious control method for the evaporated solvents is enclosure and exhausting of the dryer. The necessary openings in such an enclosure are those for entrance and exit of the fabric. Several variations of this general procedure were seen. In one, exhaust air was removed from above the fabric, while in another air was exhausted from below the steam coils. One installation provided hinged flaps along both sides of the drying tunnel to allow easy access to the fabric throughout its route. These flaps were lowered while the machine was in operation.

The design of one system indicated certain desirable features of such an installation. From each of 12 coating machine drying tunnels, handling 2.5 gal per hr of solvent, 5000 cfm of air was exhausted. This amount of air and solvent would produce about 300 parts per million (ppm) average concentration of toluol in the ductwork, allowing an adequate safety margin below the explosive limit. The overhead exhaust from the tunnel was sufficient to produce a calculated inward velocity at all openings of about 150 fpm. The minimum measured velocity was 100 fpm. Fresh tempered, humidified, and filtered air was supplied to the room at the rate of 64,000 cfm, slightly more than the total exhaust. The principal supply grilles were overhead at the feed and takeoff ends of each machine, and were baffled to prevent disturbance of the air flow into the drying tunnels. This arrangement supplied adequate fresh air to the operators. Air change in the workroom was at the rate of 40 per hr. This system had been designed for the possible use of benzol as a rubber solvent, although toluol substitutes were being used at the time.

Average concentrations of combustible vapor in the workroom were about 50 ppm. Concentrations between 30 and 60 ppm were general throughout the room, both at operating positions at the doctor blade and at locations between machines. The maximum concentration found was 150 ppm of combustible vapor, almost entirely petroleum naphtha. This sample was obtained at the head of one machine while the doctor blade was being cleaned with gasoline. Several bottle samples brought back to the laboratory for spectrographic analysis were in good agreement with the combustible indicator.

These results indicate the effectiveness of this system for controlling solvent vapors during fabric coating. While it is probable that such an elaborate system would not be required for the solvents then in use, it is felt that this system could be used safely with benzol. It might be made more economical by decreasing the size of openings into the dryers, thus reducing to a minimum the free area through which air may enter. For such drying operations it is recommended that the exhaust capacity per dryer be designed to create at least 100 fpm velocity through the necessary openings. Where possible, dope should be fed to the doctor blade by means of pipe lines. The use of gasoline washes for doctor blades and rolls is also recommended in preference to the more toxic aromatic compounds.

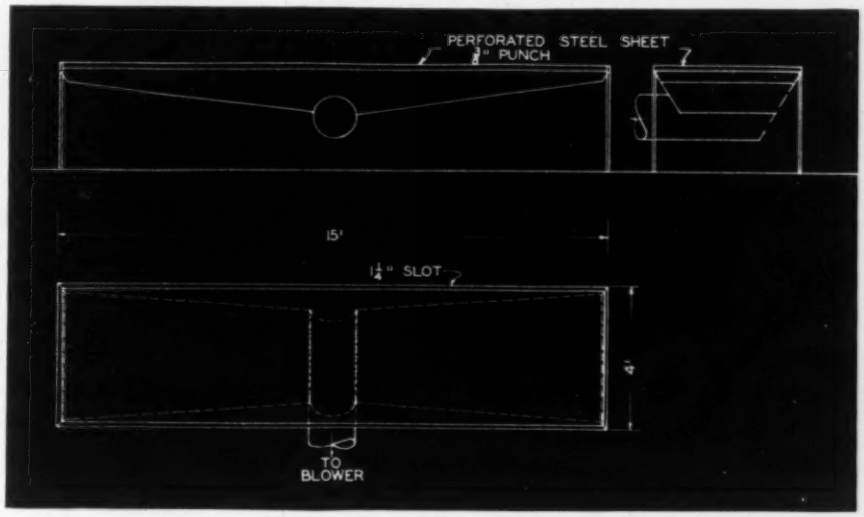


Fig. 2—Downdraft ventilated table

Balloon Fabrication

Solvents used in cements for joining sections of balloon cloth were similar to those previously discussed. Several different solvent formulas were encountered, including pure benzol, toluol-petroleum naphtha mixture, and a mixture of a toluol substitute with carbon tetrachloride and a trace of carbon disulfide. The aromatics or aromatic-petroleum mixtures were most widely used. Both petroleum naphthas and ketones were used as washes.

Military balloons were assembled by cementing together relatively small sections of coated fabric, the individual sections being cut to form the curved surfaces required. Edges to be joined were washed free of dirt and then contiguous edges were coated with cement which was allowed to dry to a tacky stage. They were then joined together, rolled tight, and a reinforcing tape applied after the exposed seam had been coated again with a small amount of cement.

In the assembly of barrage balloons which are relatively small, about 75 per cent of the joining may be done on work benches of convenient height and sufficiently wide, usually about 4 ft, to accommodate material to make

up about one-quarter of the final balloon. These larger sections are then joined together on the floor, and certain appurtenances are cemented to the surface. Finally the balloon is partially inflated and the reinforcing tapes and patches are applied to the inside.

Assembly of barrage balloons is always done in large volume rooms. This fact is itself a safety factor, since considerable natural dilution of vapors can occur. In the several plants surveyed, the volume varied from 540,000 to 1,350,000 cu ft, and the floor area from 18,000 to 45,000 sq ft. With a maximum of 110 persons employed at one time in such workrooms, it is clear that the space per person was relatively high.

Since a large proportion of the cementing is, or may be, done on benches, the logical control measure for solvent vapors is source ventilation at the tables. Several arrangements were seen for realizing this purpose, including ventilated canopy hoods over the tables, slot hood ventilators over the center of the table, and lateral slot exhaust along one or both sides of the table. Since large surfaces of solvent or washes evaporate intermittently, control measures which reduce peak concentrations to the general room concentration, are obviously effective.

Fig. 1 shows cross section details of a laterally ventilated table which was satisfactory in controlling peak exposures, and practical in production. Each of several work tables, 40 by 4 ft in top dimensions, was provided with 8000 cfm exhaust. Distribution of air over the slots was accomplished by making the entire space under the table a plenum chamber, with three connections to the exhaust duct. Air velocities over the surface of the table varied from a minimum of 50 fpm at the center line to 1200 fpm at the slot. Air distribution was good over the entire system.

The amount of ventilation was about half that suggested for similar lateral exhaust of plating tanks (7). In this case, however, there were no convection currents to be overcome, the extraneous energy sources being room turbulence and the motion of the cementing brush. Since control was effective, as will be shown later, it is suggested that for such tables, the amount of ventilation be computed from the formula $Q = 50\ LW$, where Q = quantity of air to be exhausted, cfm; and L and W = top dimensions of the table, ft.

As an alternative, a few types of patches for balloons were cemented on downdraft tables such as that shown in Fig. 2. This table was used with considerable success for removing solvent vapor after saturating frayed rope handle patches, the rope being sufficiently porous to allow air to pass through it. A cheese cloth covering over the grille to prevent plugging of the holes was changed several times per day. Total air flow through the system was about 3500 cfm.

Table 1—Approximate required quantities of diluting air for various solvents

Solvent	Allowable Concentration Ppm	Required Cu Ft of Air per Hr per Gal
Benzol	100	350,000
Toluol	200	150,000
Carbon tetrachloride	100	325,000
Ethylene dichloride	100	400,000
Carbon disulfide	15	3,450,000

As a rule, table ventilation as described above will furnish several air changes per hour in the workroom. In addition, from one to three changes can be expected from leakage at windows and doors. Except under very unusual conditions, five to 10 air changes per hour were sufficient to prevent accumulation of vapors in these workrooms. Therefore, further general air dilution appeared to be neither necessary nor desirable. As a guide for determining the adequacy of dilution, Table 1 shows approximate required quantities of diluting air per hour per gallon of several commonly used solvents.

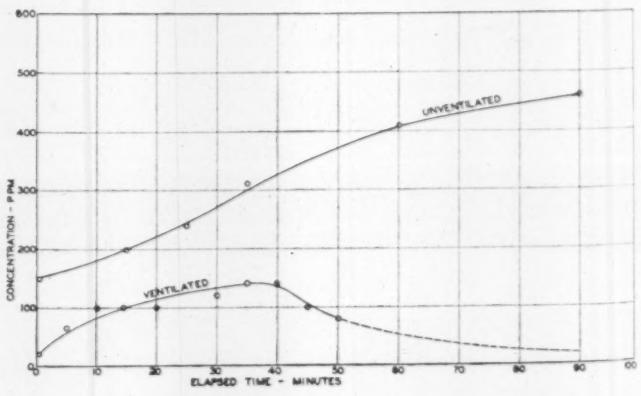
In none of four balloon rooms surveyed was the average concentration over 50 ppm of individual or mixed vapors. As indicated previously, this is attributable to the fact that all of the workrooms were very large, and natural and forced ventilation was sufficient to prevent accumulation of vapors. However, local concentrations reached peaks in some locations well above the toxic limits. It is doubtful that even these exposures were above threshold limits in the daily average. In one plant area where ventilated tables as shown in Fig. 1 were used, table cementers had no exposures to benzol above 20 ppm, their average and peak exposures being that of the general room air in the table cementing area, i.e., 10 to 20 ppm. Vapor concentration in the air entering the ventilating slot was up to 300 ppm. In another area, however, where the ventilating installation had not been completed, operators had an average exposure while cementing of 60 to 70 ppm benzol, with peak exposures of about 175 to 200 ppm. At another plant where ventilated tables were used for a smaller proportion of the total work, average room concentrations of total combustible vapors were about 40 ppm; individual exposures at ventilated tables were in the range of 40 to 70 ppm, while exposures near unventilated tables averaged slightly higher with peak concentrations in the range of 200 to 300 ppm. At the ventilated table shown in Fig. 2 in this plant, operator exposures were at the general room average of 40 ppm.

At floor cementing operations where large sections of balloon fabric were assembled, no additional ventilation was provided. Tests at floor cementing stations were uniformly low for solvent vapors, being in the range of 20 to 80 ppm in the breathing zone. Usually the operator moved away from the evaporating solvent and thus escaped maximum exposure. It appeared, therefore, that if adequate ventilation existed in the workroom for general dilution, no further ventilation was necessary at floor cementing stations. Some advantage may be gained by placing circulating fans and tempered air inlets in such a position as to create mild air movement across floor cementing areas to dilute the vapors more rapidly.

Final balloon assembly required a few operators to work inside the partially inflated balloon applying finishing tapes and completing a few terminal seams. Unless air is continually fed to the balloon, its interior is a confined and unventilated space of about 15,000 cu ft. Evaporation of solvents in such a space may build up rapidly a relatively high concentration as shown in the upper curve of Fig. 3, which shows results of tests in an unventilated balloon. Over a period of 1½ hr, concentration of combustible vapor increased regularly to 450 ppm.

The lower curve of Fig. 3 shows results in another balloon into which air was continuously fed from the inflating blower at a rate of about 1000 cfm and allowed to escape from a second port. Under conditions similar to those of the first case, the concentration increased slowly to only 140 ppm and appeared to be at a peak plateau. When operations ceased, the concentration dropped rapidly. It can be calculated that without ventilation, con-

Fig. 3—Vapor concentrations in ventilated and unventilated balloon



centration of benzol within the balloon would have increased in the same length of time to about 350 ppm. The procedure required no new equipment, and only the slight operating modification of smothering the balloon at a convenient degree of inflation. There was no inconvenience to operators, and a decided reduction in the atmospheric contamination. It was found during this investigation that nearly all of the vapor in the balloon was due to immediate operations, and only a small part of it came from previously entrapped vapor or solvent.

Airplane Fuel Tank Fabrication

Ethylene dichloride was the most toxic solvent used in the fabrication of selfsealing fuel cells, others being ketones and petroleum naphthas.

Fuel cells were fabricated by cementing together, over a form, several layers of natural or synthetic rubber, some of which were coated or calendered into fabric and some of which were in sheet form. Single plys were tailored by hand to fit a mold which was later removed by disintegration. For the inner ply, which is of synthetic rubber to resist the action of gasoline, ethylene dichloride was used as a cement solvent and as a tackifier. The plys of natural rubber may be cemented and washed with petroleum naphthas.

A small part of the preliminary cementing may be done on ventilated tables such as those previously described. For the most part, however, cementing and tackifying were done on the formed cell which, for convenience, was placed on a low pedestal. In this position, cement and tackifier were brushed intermittently over large areas to prepare seams, insertions, and edge reinforcements as well as to tackify surfaces for cementing subsequent layers. Without adequate ventilation, these operations may cause considerable vapor exposure to operators and others in the vicinity.

At the time of the survey, the production rate was low and no air samples representing full production could be obtained. Samples taken during a period of low production in the summer were uniformly low for ethylene dichloride, being in the range of 20 to 90 ppm without induced ventilation. Natural ventilation from open windows was good. It is well to note from Table 1 that ethylene dichloride requires a larger amount of diluting air to maintain safe concentration than does an equal volume of benzol.

Without the test of actual installations, none of which have been seen in operation, we are reporting two methods which appear to be of possible value in reducing potential vapor exposure from this work. In any case, it is important to segregate work requiring the use of noxious solvents from that in which petroleum naphthas or gasoline is an adequate solvent.

Fig. 4 indicates an arrangement for source ventilation at the working surfaces of the fuel cells. The pedestal on which the cell rests is an open bottom shell, the top of which approximates the shape of the cell but leaves an annular ring around it. Through a floor duct, sufficient air is drawn to create a downdraft past the top edges of the cell. It is felt that the velocity at the working surface should be about 100 fpm for adequate control. For calculations of required air, the following formula is an approximation: $Q = 200 \quad H\,(L + W)$, where Q = quantity of air to be exhausted, cfm; H = distance from top of shell to top of cell, ft; L and W = length and width of shell, ft.

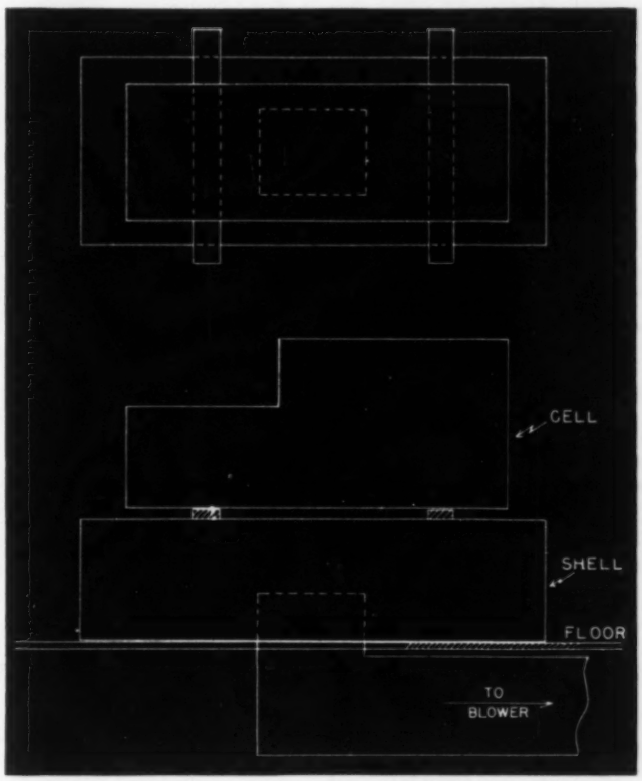


Fig. 4—Sketch of ventilation for fabrication of fuel tanks

For such a system, supply air must be so distributed as not to create turbulence at the working surfaces.

As an alternative, work on the cells may be done in booths from which sufficient air is withdrawn to create a face velocity of about 100 fpm. This arrangement should give adequate control if work is done from the face side of the booth. Air should be withdrawn from the booth near the floor level. The amount of air required is approximated by the formula $Q = 100\ HW$, where H and W = face dimensions of the booth, ft.

This system might have some advantages of economy, since axial flow fans could be used and little or no ductwork would be required if such booths were along the outside walls.

Rubber Boat and Pontoon Fabrication

During this survey, only gasoline or other petroleum naphthas were being used as washes and cement solvents, since the fabric coating was entirely of natural rubber. Therefore, no samples were taken at this operation. The work is similar to that in fabrication of balloons, some of the cementing being done on tables and some on the floor. No cementing was required in completely enclosed spaces.

Although the health hazard from gasoline vapor was not severe, one plant had under consideration a design for exhaust ventilation to reduce vapor concentrations. The quantity of air to be exhausted from and made up in the workroom was based on the average hourly consumption of solvent. Gasoline vapor was to be diluted to about 100 ppm, the air being withdrawn in such a way as to provide source ventilation for cementing and washing jobs. Table operations were to be ventilated as previously described, with somewhat lower air flow per square foot of table. For cementing on final assembly of cylindrical shapes, downdraft ventilation was to be provided from the base of the pedestal on which the inflated part was being assembled. For dilution at locations where local exhaust was difficult or impossible, an excess of makeup air was to be directed toward the working station through movable semi-rigid canvas ducts, the supplied air to be filtered and tempered.

Synthetic Rubber Production

Although a majority of the synthetic buna rubber to be produced will be buna S (butadiene-styrene copolymer), some buna N (butadiene-acrylonitrile copolymer) will continue in production. Of the materials used,

only acrylonitrile offers a potential serious health hazard (2). This hazard is largely one of acute poisoning, according to present knowledge, but it has been indicated that acute poisoning may occur at low concentrations.

Fig. 5 indicates the steps in processing raw materials to synthetic buna rubber. Organic reactants were stored in tanks and handled by pipe line throughout. The polymerization reaction was accomplished in emulsion, usually in soap water. The reaction vessel was closed and under pressure up to 65 psi. In the three plants visited, no attempt was made to recover excess acrylonitrile, so that the reacted mixture was transferred directly from reactor to a semi-enclosed vat where addition of electrolytes caused coagulation. From this point to the dryer there existed potential exposure to excess acrylonitrile, since operations were either open or semi-enclosed. Some variation in procedure was seen in the three plants; for example, the lack of a drying step in one of them.

No attempts were made to obtain air samples for acrylonitrile since no adequate method existed. Observation of the process, however, indicated several points at which precautions should be taken when acrylonitrile is used:

Leaks or breaks in pipe lines carrying acrylonitrile would be serious hazards. Personnel should leave the affected area immediately, and those who return to close valves and remove the residue should be equipped with gas masks approved by the U. S. Bureau of Mines for protection against organic vapors. Spilled nitrile should be washed down drains with copious amounts of water. Contact with the liquid should be prevented by use of rubber footwear and gloves, as it may be absorbed through the skin.

Cleaning of reaction vessels after each batch operation is a severe potential hazard. Before a man enters the vessel, it should be purged by ventilation through a duct extending to the bottom of the vessel. The volume of air purged should be at least 20 times that of the container. In addition, the man entering the reactor should be equipped with a lifeline manipulated by another person outside the tank, and rubber footwear and gloves to prevent skin contact with the sludge and loose material in the tank.

Under normal operating conditions, some vapor exposure was possible in operations from the coagulator to the final press baling. To expedite inspection of the material, part of the top or inspection openings of the coagulator were usually left open. The vat should be equipped with sufficient suction ventilation to create an inward draft of about 100 fpm through such openings to prevent escape of unreacted vapors.

Dewatering and washing operations at the separator may produce vapor exposure. Either enclosure of filters or adequate local exhaust should be provided. Centrifuges, particularly, may produce considerable displacement of air and vapor into the surrounding atmosphere, and adequate exhaust ventilation should be provided at the periphery of the basket. Additional general ventilation may be required also.

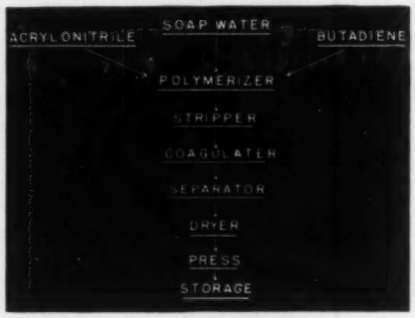


Fig. 5—Flow sheet for buna N synthetic rubber

Ventilation of enclosed conveyor dryers is essential for the removal of water vapor and other residues evaporated from the stock. To prevent escape of these materials into the workroom, ventilation should be sufficient to provide an inward air velocity of 100 fpm at all openings of the dryer.

As far as is now known, the dried product presented no further hazard, and the final baling operation was innocuous. However, if baling or milling is done on the undried product, as noted in one plant, some vapor may be evolved from heat of compression. In such case, local exhaust ventilation should be provided to remove contaminants from the mill or press.

Conclusion

Increasing use of synthetic rubber may intensify the use of toxic solvents in rubber fabrication. Operations now performed with petroleum fractions may require aromatic solvents, or others of equal toxicity. Such changes must be considered as introducing industrial hygiene problems, whose solution should be made an integral part of the planning program so that production will not be hampered at a later date by illness or psychological disturbances among the operators.

The authors are grateful for the assistance throughout the survey of Dr. A. D. Brandt, P. A. Sanitary Engineer, and to Dr. P. A. Neal, Surgeon, both of the U. S. Public Health Service.

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INQUIRY SERVICE AIDS BUSINESS MEN ON WAR WORK

Business men seeking solutions to their war production problems now have at their disposal a unit of trained specialists in Washington whose job it is to answer their questions or refer them to the proper WPB officials, according to the OWI. The service is designed to eliminate confusion and delays on the part of business men who want information about where to take their problems. The main unit, consisting of a telephone inquiry service, has set up headquarters in room 1501, Social Security building, on Independence Ave. between Third and Fourth Sts., Washington, D. C.

Because of its location, close to the building entrance, visitors need no passes or badges. The unit is a subdivision of the business services branch of the administrative division of WPB. In the same room WPB press releases, forms, orders, and regulations are available.

The central telephone number is Republic 7500. The telephone service unit has extension 73011. The press release extension is 71411. The industry advisory service can be reached through extensions 72801, 72802, 72803, 74203, and 74231.

Separate liaison services are maintained in room 304-A in the old House Office building and in 10-B Senate Office building. A third such office is in the Information Center, 1400 Pennsylvania Ave.

What Temperature Can Be Maintained Under Fuel Oil Rationing Program?

J. K. Peebles, Jr., Shows Use of Degree Days to Figure Probable Inside Temperature When Allowable Fuel Consumption Must Be Reduced

SUMMARY — An important fuel oil rationing question which those who have been working on rationing problems and those responsible for operating heating plants have had to answer many times is the probable inside temperature that can be maintained when fuel consumption is cut. Mr. Peebles has done it by calculating the degree days for a series of different base temperatures other than the standard base temperature of 65 F which is used for an inside temperature of 70 F. . . . His data indicate that in New York City, for example, if 74 F was the inside temperature with normal fuel consumption, 65 F can be carried with two-thirds of normal fuel consumption. . . . Mr. Peebles, of Baskervill & Son, architects, is a member of the state advisory committee for Virginia on fuel oil rationing.

THE STATEMENT by Allen J. Johnson, Oil Rationing Plan Doesn't Guarantee 65 F, which appeared on The Editor's Pages of the January HPAC, gives a darker outlook on fuel oil rationing than is apparently the case. It is true that 65 F—or any other temperature, for that matter—is not guaranteed by the fuel oil rationing plan. However, it is interesting to note that when the degree day basis is used in estimating the probable temperature that can be maintained with two-thirds of the fuel oil used during a normal season, the situation is not as bad as pictured.

As an example, consider New York City. Not having the Weather Bureau's figures for the daily normal mean temperatures for New York, I have resorted to the use of daily normal high and low temperatures for that city which have been taken from the World Almanac for 1943.

From this information the daily normal mean temperatures were determined and the degree days computed for the entire season for various inside temperatures.* The base for the degree day calculations was, in each case, taken as 5 F below the inside temperature. The result of these calculations gave the results as shown here; corresponding figures for other cities will show similar results.

Inside Temperature, F	Degree Days
75	6616
74	6333
73	6058
72	5790
71	5529
70	5275
69	5029
68	4789
67	4555
66	4328
65	4107
64	3892
63	3682
62	3479
61	3280
60	3087

It will be noted that the degree day figure for an inside temperature of 70 F is slightly less than that published in the ASHVE Guide. This is undoubtedly due to the different sources used for the normal mean temperature and is probably reflected throughout the computations, but the discrepancy is not such as materially to affect the conclusions reached.

With an inside temperature of 70, the degree day method has been proved to be more accurate in estimating fuel consumption than the method of using the difference between the outside and inside temperatures. It is only logical that the same principle can be applied several degrees either side of 70 without introducing serious error.

If it is assumed that degree days set forth above for the various inside temperatures are a relative measure of the fuel oil consumption, it will be noted that two-thirds of 5275, the degree days for 70, amounts to 3517 degree days and is slightly more than the degree days for 62. If the problem is looked at in the reverse, one and one-half times 4107, the degree days for 65, amounts to 6160 degree days, slightly less than the degree days for 74 F.

Therefore it appears that if a person normally maintained a temperature of 70 F, he would be able to maintain a temperature of 62 F with two-thirds of his normal supply of fuel oil, as compared with the 60 F as stated by Mr. Johnson. Likewise, if he normally maintained a temperature of 74 (not 80, as stated by Mr. Johnson) he would be able to maintain 65 with a fuel oil allotment of two-thirds that required for a normal year.

It is my conviction that most persons actually maintain temperatures in excess of 70 and, while I do not believe they maintain a temperature of 74, I think the excess over 70 which they normally maintain, plus such precautions to save fuel oil as they would be able to make, such as checking the operation of the burner, insulating, weatherstripping, etc., would permit them to maintain a temperature in excess of the 60 suggested by Mr. Johnson and probably close to 65.

The conditions set forth above not only encourage people to take all possible steps to conserve fuel but, in reality, force them to take these steps, if they wish to maintain a temperature of 65. This merely emphasizes one of the very good principles of the regulations, which is to provide sufficient oil to maintain a minimum livable temperature, provided the person responsible for the heating plant does everything possible to conserve fuel oil.

It might be pointed out that those who took these precautions prior to the emergency have had these savings reflected in their consumption of fuel oil for the previous year and, therefore, were probably rewarded with more than two-thirds of a normal year's supply to offset the fact that they cannot now make further savings.

Attention is also called to the fact that if one maintained a temperature of 80 F last year, or otherwise wasted fuel oil, the regulations would not reward him with enough oil to be very comfortable (as suggested by Mr. Johnson) but, fortunately, would penalize him for this waste, by giving him less than two-thirds of his normal year's requirements. This is a very commendable feature of the regulations and tends toward a more equitable distribution of fuel oil consistent with minimum requirements.

Since I have the figures at hand for Richmond, Va., it might be of interest to note the comparison of the above with those of a city with a warmer climate than New York. Using the degree day basis for Richmond, if one normally maintained a temperature of 70, he would be able to maintain 63.7 with two-thirds of a normal year's supply of oil, or if he normally maintained 71.6, he would be able to carry 65 with two-thirds of his normal oil use.

*For any one day there exists as many degree days as there are degrees Fahrenheit difference in temperature between the mean temperature for the day and the base temperature. The daily mean temperature is the average of the maximum and minimum temperatures for the day. Thus, for a maximum temperature of 24 F and a minimum temperature of 8 F in one day, the mean temperature is 16 F. For an inside temperature of 70 F, the base temperature is 65 F. The difference between 65 F and 16 F, or 49, is the number of degree days for that day. Maximum, minimum, and mean temperatures are shown on U. S. Weather Bureau form No. 1030.

Supplementary Plane Pipe Bends

Samuel C. Zinman Presents Combined Graphical and Analytical Method for the Solution and the Transfer of Supplementary Plane Pipe Bends from the Drawing Board to the Shop for Fabrication

SUMMARY—A combined graphical and analytical method is presented for the solution and transfer of supplementary plane pipe bends, as encountered in ship construction, from the drawing board to the shop for fabrication. . . . In the general solution of bends involving more than one list angle, the author has eliminated the "breaking" of the middle lengths and the subsequent layout of the true lengths and angles since they are calculated as part of the analytical solution. However, if the required accuracy of solution permits one which is entirely graphical, then the above convention may be used and the true lengths and angles scaled. . . . The author has had considerable experience in marine and other piping design, and until recently was an assistant mechanical engineer with New York City's board of water supply. This is the second of two articles; the first was published in February.

THIS ARTICLE is intended for piping engineers, draftsmen, and shop men who lay out and design piping which does not show its true shape in the ordinary planes of projection. Piping of this nature is generally encountered in ship construction, boiler tubing, and sometimes land piping. The methods of solution of this problem are also adaptable to the layout of intersecting planes requiring the finding of the dihedral angle and other pertinent information that may occur in ductwork or any similar three dimensional problems.

Multi-List Angles

The extension of the principles and formulas given in my article in the February HPAC to problems involving more than one list angle (as in problems shown in Figs. 6, 7, and 8) is not difficult. However, since more than two planes are involved, a standardization of procedure is required for simplification and clarification. Two additional factors will be introduced toward this end.

The first is the direction of rotation of the list angle (clockwise or counterclockwise), and the second is the direction of bend in the bending plane (right or left).

It is evident that the angle between two planes can be measured in two ways, i.e., by the angle itself and its supplement. Hence, the list angle rotation may be one or the other. In order to facilitate the determination of the direction of rotation, the following rule will be adopted:

"If a bend is made to the right, the list angle rotation immediately following will be counterclockwise. If a bend is made to the left, the list angle rotation immediately following will be clockwise."

A glance at Fig. 3, on p. 87, February HPAC, will immediately make this rule clear. From position A to B, a bend is made to the right. Now, the list angle rotation immediately following will have to be counterclockwise (position C), since rotating away from the bending plane is generally the easiest way.

Notice that the bend "to the right" presumes that the observer is standing on the bending plane. It will be seen in Fig. 7 that once this arbitrary

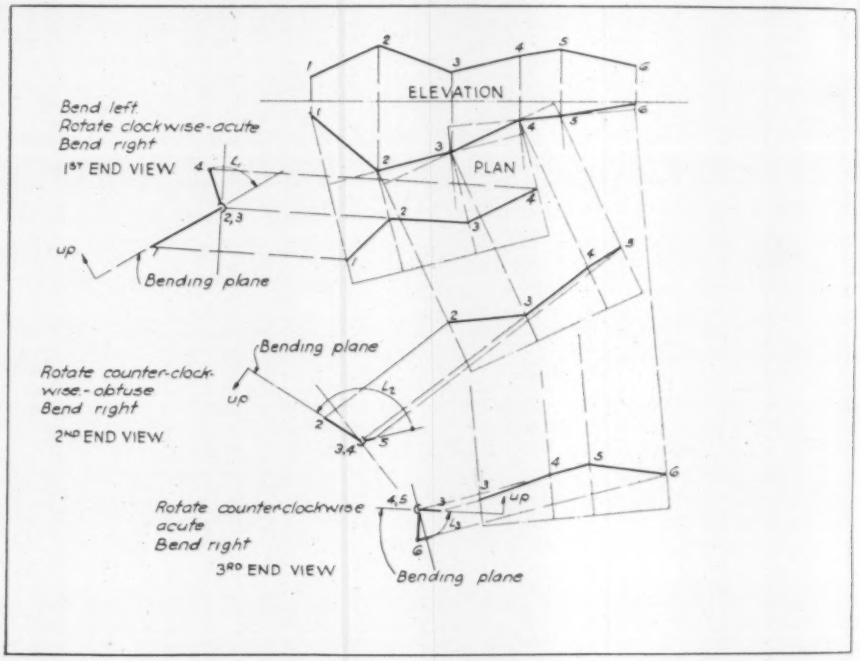


Fig. 7

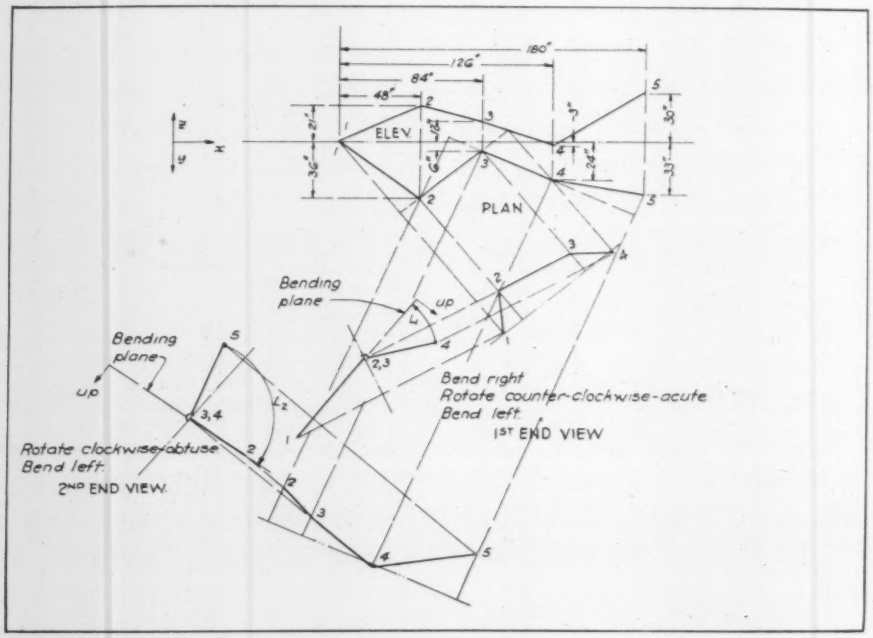


Fig. 6

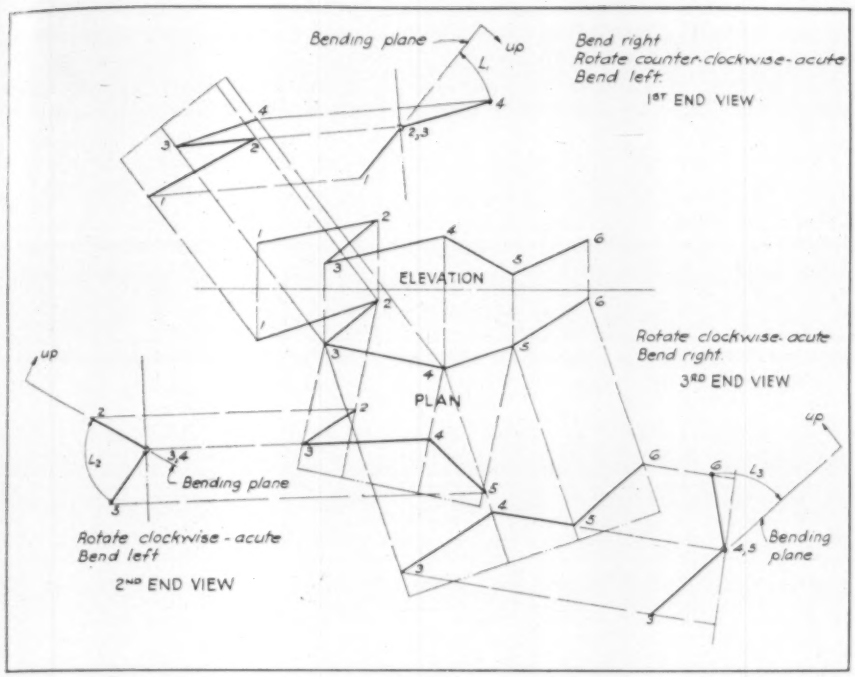


Fig. 8

position of the observer is chosen in the "1st end view" (the word "up" and the arrow indicate the ceiling of the bending room and hence the bending plane will be the floor), all succeeding end views would necessitate the finding of the up position relative to its preceding end views.

This relationship may be found as follows (see Fig. 7): In the "1st end view," after rotation through the first list angle has been accomplished and the bend of line *3-4* made, if an observer were standing in the bending plane and sighting along line *2-3*, the line *3-4* would appear to the right of *2-3*. This condition must be satisfied in the "2nd end view." Here, the only possible position in which the observer could be located and sight along line *2-3* with the line *3-4* appearing to the right of *2-3*, would be if "up" were indicated as shown with the arrow.

Likewise, the "up" position of the "3rd end view" would depend upon the relative position of the line *3-4* to line *4-5* after *4-5* has been rotated into the bending plane and viewed by an observer standing in the bending plane of the "2nd end view" . . . and so on.

General Procedure for Multi-List Angles

A) Graphical Solution

1) Draw plan and elevation of piping using projections of center lines and points of intersections of tangents to bends. (The points of intersection are numbered *1*, *2*, *3*, *4* . . ., starting from left to right continuously in the plan and correspondingly numbered on all other projected views (see Fig. 6).

2) Consider only three lengths at a time. Start with the first three lines (*1-2*, *2-3*, and *3-4*) for the first list angle, true lengths of lines, etc. Lines *2-3*, *3-4*, and *4-5* will be used for the second list angle, true lengths of lines, etc. (see Fig. 6).

3) Take a section parallel to line *2-3* of the plan and it thereafter is to

Symbols and Definitions

Points in space indicated by numbers, *1*, *2*, *3*, *4*, etc., are the points of intersection of the true tangents to the bends.

$A_{1\text{-}2}$, $A_{2\text{-}3}$, $A_{3\text{-}4}$ are the true distances between the points of intersections in space in succession. Thus, the distances from *1* to *2*, *2* to *3*, etc., have distances $A_{1\text{-}2}$, $A_{2\text{-}3}$, etc.

$A_{1\text{-}3}$, $A_{2\text{-}4}$, $A_{3\text{-}5}$ are the true distances between alternate points of intersection in space. Thus, the distances from *1* to *3*, *2* to *4*, etc., have distances $A_{1\text{-}3}$, $A_{2\text{-}4}$, etc.

a_1, a_2, a_3, a_4 are the true angles between $A_{1\text{-}2}$ and $A_{2\text{-}3}$, $A_{3\text{-}4}$ and $A_{4\text{-}5}$, etc., and opposite $A_{1\text{-}3}$, $A_{2\text{-}4}$, $A_{3\text{-}5}$, etc.

L_1, L_2, L_3, L_4 are list angles. Also dihedral angles. Angles between successive planes. Angles of rotation.

t_1, t_2, t_3 are tangent lengths between bends.

R is the radius of bend.

End View—Section showing three lines with middle line appearing as a point, which means a section showing intersection of two planes with the line of intersection appearing as a point.

FIG. 9—ANALYTICAL SOLUTION

True lengths of lines and true angles

For plane n

$$A_{n\text{-}(n+1)}=\sqrt{(x_{n+1}-x_n)^2+(y_{n+1}-y_n)^2+(z_{n+1}-z_n)^2}$$

$$A_{(n+1)\text{-}(n+2)}=\sqrt{(x_{n+2}-x_{n+1})^2+(y_{n+2}-y_{n+1})^2+(z_{n+2}-z_{n+1})^2}$$

$$A_{n\text{-}(n+2)}=\sqrt{(x_{n+2}-x_n)^2+(y_{n+2}-y_n)^2+(z_{n+2}-z_n)^2}$$

$$S_n=\frac{A_{(n+1)\text{-}n}+A_{(n+2)\text{-}(n+1)}-A_{(n+2)\text{-}n}}{2}$$

$$\cos\frac{\alpha_n}{2}=\sqrt{\frac{S_n(S_n-A_{(n+2)\text{-}n})}{A_{(n+2)\text{-}(n+1)}\times A_{(n+1)\text{-}n}}}$$

For plane n+1

$$A_{(n+1)\text{-}(n+2)}=\sqrt{(x_{n+2}-x_{n+1})^2+(y_{n+2}-y_{n+1})^2+(z_{n+2}-z_{n+1})^2}$$

$$A_{(n+2)\text{-}(n+3)}=\sqrt{(x_{n+3}-x_{n+2})^2+(y_{n+3}-y_{n+2})^2+(z_{n+3}-z_{n+2})^2}$$

$$A_{(n+1)\text{-}(n+3)}=\sqrt{(x_{n+3}-x_{n+1})^2+(y_{n+3}-y_{n+1})^2+(z_{n+3}-z_{n+1})^2}$$

$$S_{n+1}=\frac{A_{(n+2)\text{-}(n+1)}+A_{(n+3)\text{-}(n+2)}+A_{(n+3)\text{-}(n+1)}}{2}$$

$$\cos\frac{\alpha_{n+1}}{2}=\sqrt{\frac{S_{n+1}(S_{n+1}-A_{(n+3)\text{-}(n+1)})}{A_{(n+3)\text{-}(n+2)}\times A_{(n+2)\text{-}(n+1)}}}$$

List angles

For plane n

$$E_n=(y_{n+1}-y_n)(z_{n+2}-z_n)-(y_{n+2}-y_n)(z_{n+1}-z_n)$$

$$F_n=(x_{n+1}-x_n)(z_{n+2}-z_n)-(x_{n+2}-x_n)(z_{n+1}-z_n)$$

$$G_n=(x_{n+1}-x_n)(y_{n+2}-y_n)-(x_{n+2}-x_n)(y_{n+1}-y_n)$$

For plane n+1

$$E_{n+1}=(y_{n+2}-y_{n+1})(z_{n+3}-z_{n+1})-(y_{n+3}-y_{n+1})(z_{n+2}-z_{n+1})$$

$$F_{n+1}=(x_{n+2}-x_{n+1})(z_{n+3}-z_{n+1})-(x_{n+3}-x_{n+1})(z_{n+2}-z_{n+1})$$

$$G_{n+1}=(x_{n+2}-x_{n+1})(y_{n+3}-y_{n+1})-(x_{n+3}-x_{n+1})(y_{n+2}-y_{n+1})$$

List angle between n and n+1

$$\cos L_n=\frac{E_nE_{n+1}+F_nF_{n+1}+G_nG_{n+1}}{\sqrt{E_n^2+F_n^2+G_n^2}\times\sqrt{E_{n+1}^2+F_{n+1}^2+G_{n+1}^2}}$$

Tangent distance for plane n

$$t_n=A_{n\text{-}(n+1)}-R\left(\tan\frac{\pi-\alpha_{n-1}}{2}+\tan\frac{\pi-\alpha_n}{2}\right)$$

Note – All above formulas are applicable to planes that are not in succession, such as n and n+5. The study of the graphical solution for a particular problem will determine whether L_n is acute or obtuse.

be considered as rotated into the plane of the plan (see section *S-S*, Fig. 4, p. 87, February HPAC).

4) Take a section *E-E* perpendicular to line *2-3* as projected in section *S-S*. We then have line *2-3* shown as a point and we view both planes that constitute the list angle "on end" (Fig. 4, p. 87, February HPAC).

5) The list angle is between the prolongation of the plane formed by lines *1-2*, *2-3*, and the plane formed by *2-3*, *3-4*. Notice that the angle may be either acute or obtuse. Also note that the bending plane is always the plane made up of the lowest point of intersection numbers. Thus, in Fig. 6, *1-2-3* indicates the bending plane in the "1st end view," and *2-3-4* constitutes the bending plane in the "2nd end view."

6) Arbitrarily select the "up" position in the "1st end view" and mark with arrow (Fig. 6).

7) Viewing the "1st end view" from the proper position (the arrow pointing to the ceiling of the bending room), determine the direction of the first bend. In Fig. 6, line *2-3* is to the right of line *1-2*. Hence it follows from the bend rotation rule that the list angle rotation is counterclockwise as shown by the circular direction line *L*. Thus, *L* is acute in this case. After rotation the bend is left. All this information should be noted near the corresponding end view as shown in Fig. 6.

8) Draw the "2nd end view." The first section is taken parallel to line *3-4* in the plan and the procedure duplicated as in the first case. Note that in taking the section parallel to *3-4* in the plan, the lower point of intersection (No. *3*) should be to the left (Fig. 6). This standardized procedure simplifies analysis for more complicated piping.

9) From the "1st end view" determine the proper relationship between the lines *3-4* and *2-3* after *3-4* has been rotated into the bending plane. In Fig. 6, line *3-4* is to the left of *2-3*.

10) Hence locate the "up" position in the "2nd end view." Also determine the direction of rotation from the last bend of the "1st end view." Since the bend was to the left in Fig. 6, the rotation of the list angle is clockwise and obtuse. The final bend is to the left.

B) Analytical Solution

Extending the derived formulas for one list angle (two planes) to the general case for planes and we have the analytical solution shown in Fig. 9.

When all the necessary information has been assembled, it is advisable that a table similar to the one shown in Fig. 10 be prepared for the shop so that no working drawings will ordinarily be required.

FIG. 10 – SHOP TABLE

Figure		6	7	8			
Pipe Diameters	D	2"					
Radius of Bend	R	10"					
Tangent	t_1	54.98"					
Bend	Angle $\pi-\alpha_1$	81°-18'					
	Direct.	Right	Left	Right			
Tangent	t_2	33.22"					
List	Angle L_1	36°-35'	Acute	Acute			
	Direct.	Counter-clockwise	Clockwise	Counter-clockwise			
Bend	Angle $\pi-\alpha_2$	61°-10'					
	Direct.	Left	Right	Left			
Tangent	t_3	37.41"					
List	Angle L_2	102°-33'	Obtuse	Acute			
	Direct.	Clockwise	Counter-clockwise	Clockwise			
Bend	Angle $\pi-\alpha_3$	51°-00'					
	Direct.	Left	Right	Left			
Tangent	t_4	59.15"					
List	Angle L_3		Acute	Acute			
	Direct.		Counter-clockwise	Clockwise			
Bend	Angle $\pi-\alpha_4$						
	Direct.		Right	Right			
Tangent	t_5						
Shop Check		185.44					

NOTE – Fig. 6, complete solution. Figs. 7 and 8, graphical only.

Problems Solved

Three problems will now be solved, the first having both graphical and analytical solutions and the second and the third the graphical solution only (see Fig. 11).

Notice that in the graphical part of the problem diagrammed in Fig. 6 the coordinates of point *1* (x_1, y_1, z_1) start at the origin and hence $x_1=0$, $y_1=0$, $z_1=0$. Since it is advantageous to place the origin at this point from the analytical standpoint, but for clarification of drafting it is better to spread the plan and elevation, it is suggested that in the two views, the graphical layout be somewhat separated with the understanding that the analytical solution start with $x_1=0$, $y_1=0$, $z_1=0$. This separation is illustrated in the problems in Figs. 7 and 8.

Also note that the analytical solu-

FIG. 11 – ANALYTICAL SOLUTION FOR FIG. 6

$x_1=0$ $y_1=0$ $z_1=0$
$x_2=48$ $y_2=36$ $z_2=21$
$x_3=84$ $y_3=6$ $z_3=12$
$x_4=126$ $y_4=24$ $z_4=-3$
$x_5=180$ $y_5=33$ $z_5=30$

$A_{1-2}=\sqrt{(48)^2+(36)^2+(21)^2}=63.57$ $\quad A_{1-3}=\sqrt{(84)^2+(6)^2+(12)^2}=85.07$

$A_{2-3}=\sqrt{(36)^2+(30)^2+(9)^2}=47.72$ $\quad A_{2-4}=\sqrt{(78)^2+(-12)^2+(-24)^2}=82.49$

$A_{3-4}=\sqrt{(42)^2+(18)^2+(15)^2}=48.09$ $\quad A_{3-5}=\sqrt{(96)^2+(27)^2+(18)^2}=101.34$

$A_{4-5}=\sqrt{(54)^2+(9)^2+(33)^2}=63.92$ $\quad A_{1-5}=\sqrt{(180)^2+(33)^2+(30)^2}=185.44$ (Shop check)

$A_{1-2}=63.57$ $\quad A_{2-3}=47.72$ $\quad A_{3-4}=48.09$
$A_{2-3}=47.72$ $\quad A_{3-4}=48.09$ $\quad A_{4-5}=63.92$
$A_{1-3}=85.07$ $\quad A_{2-4}=82.49$ $\quad A_{3-5}=101.34$
$2S_1=196.36$ $\quad 2S_2=178.30$ $\quad 2S_3=213.35$
$S_1=98.18$ $\quad S_2=89.15$ $\quad S_3=106.68$

$\cos\frac{\alpha_1}{2}=\sqrt{\frac{98.18(98.18-85.07)}{63.57\times47.72}}$ $\quad \cos\frac{\alpha_2}{2}=\sqrt{\frac{89.15(89.15-82.49)}{47.72\times48.09}}$ $\quad \cos\frac{\alpha_3}{2}=\sqrt{\frac{106.68(106.68-101.34)}{48.09\times63.92}}$

$\alpha_1=98°-42'$ $\quad \alpha_2=118°-50'$ $\quad \alpha_3=129°-00'$
$\pi-\alpha_1=81°-18'$ $\quad \pi-\alpha_2=61°-10'$ $\quad \pi-\alpha_3=51°-00'$

$n=1$ $\quad E_1=(36)(12)-(6)(21)=306$ $\quad n=2$ $\quad E_2=(-30)(-24)-(-12)(-9)=612$
$F_1=(48)(12)-(84)(21)=-1188$ $\quad F_2=(36)(-24)-(78)(-9)=-162$
$G_1=(48)(6)-(84)(36)=-2736$ $\quad G_2=(36)(-12)-(78)(-30)=1908$

$n=3$ $\quad E_3=(18)(18)-(27)(-15)=729$
$F_3=(42)(18)-(96)(-15)=2196$
$G_3=(42)(27)-(96)(18)=-594$

Between $n=1$ and $n=2$

$$\cos L_1=\frac{(306)(612)+(-1188)(-162)+(-2736)(1908)}{\sqrt{(306)^2+(1188)^2+(2736)^2}\times\sqrt{(612)^2+(162)^2+(1908)^2}}$$

$=36°-35'$ (acute)

$$\cos L_2=\frac{(612)(729)-(162)(2196)-(594)(1908)}{\sqrt{(612)^2+(162)^2+(1908)^2}\times\sqrt{(729)^2+(2196)^2+(594)^2}}$$

$=77°-27'$
$=102°-33'$ (obtuse)

Tangents lengths between bends

$R=10$ $\quad n=1$ $\quad t_1=63.57-10\tan(40°39')=54.98$
$n=2$ $\quad t_2=47.72-10[\tan(40°39')+\tan(30°35')]=33.22$
$n=3$ $\quad t_3=48.09-10[\tan(30°35')+\tan(25°30)]=37.41$
$n=4$ $\quad t_4=63.92-10\tan(25°30')=59.15$

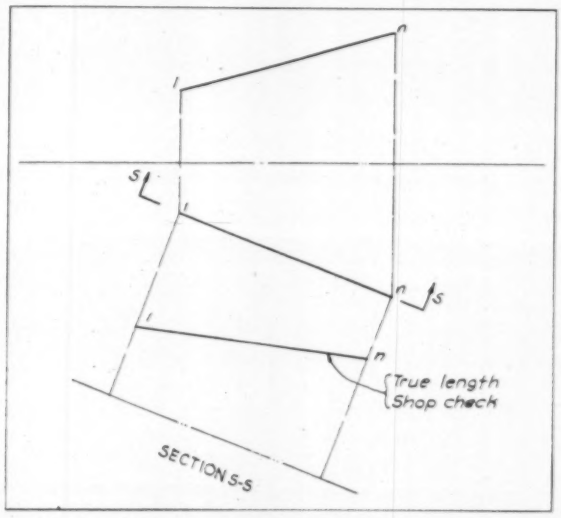


Fig.12

tion of the problem in Fig. 6 includes a shop check (see Fig. 10). This is the overall distance from point *1* to point *5* in space and is a final check of field conditions.

The shop check may also be obtained graphically by laying out the coordinates of the starting and finishing points in the two planes of projection and taking a section through either projection (see Fig. 12). Since the analytic shop check can be calculated quite simply and gives the exact overall error, it is advisable to obtain the check analytically.

Air Conditioning Makes Possible

Precision Production for War

Some of the Ways Air Conditioning Is Serving on the Production Front Told by L. W. Clifford

SUMMARY — Air conditioning has gone to war — in so many ways and for so numerous applications that it has been difficult for the record to keep up with the developments. . . . Mr. Clifford, sales development supervisor, Westinghouse Electric & Mfg. Co., outlines the requirements of gage rooms, food concentration, flying suit storage, gear cutting, parachute testing and storage, abrasives manufacturing, and the optical industry.

WARTIME CONDITIONS have created a demand for production tolerances and precision manufacturing formerly unheard of outside the laboratory. Interchangeability of parts in the many theaters of war, the delicate controls and mechanisms in the newly developed high speed machines of war, and the standardization of design suitable to mass production have all made necessary production finesse and accuracy to the *nth* degree.

Gages—No piece, large or small, can be more precise or more accurate than the gages which check it. Gages out of calibration through misuse, or gages which have been checked against the master gage under widely varying conditions, will invariably lead to misfits and costly rejects. Air conditioning in the gage room therefore protects against the damaging effects of varying temperature and relative humidity.

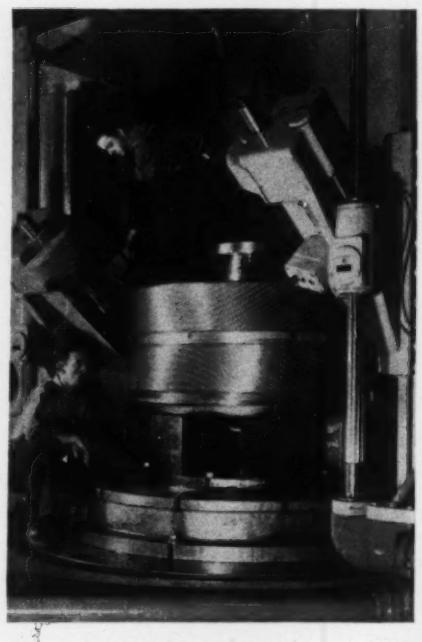
The temperature in these rooms is usually held at about 68 F dry bulb and the relative humidity at about 50 per cent. The tolerances are extremely important. One experienced tester has stated that when the test room temperature has varied over 1 F he can tell it in his gages. Therefore tolerances are usually held at ±1 F. Relative humidity is usually held within ±5 per cent of the desired point. Because of the danger of destructive condensation on gage surfaces, excessively high relative humidity must be avoided.

Citrus Fruit Concentrate Storage—In the face of a shortage of transoceanic shipping facilities, the "concentration" of foods is a vital war activity.

The concentration of grapefruit and orange juices is similar to the process used in the milk industry; the processing of 88 lb of juice results in a concentrate, very similar to marmalade, weighing 11 lb. The concentrate is first cooled to 90 F by water, and is further cooled, in 1 gal cans in which it is stored, in refrigerated rooms held at approximately 35 F. This cooling period is usually about 48 to 60 hr and is provided to prevent "aging" of the concentrate.

The specific heat of the concentrate is between 0.45 and 0.55. As a result it is relatively easy to calculate the refrigeration requirements if the ambient temperatures, insulation thickness, and weight of product are known.

In one plant, the daily production is 77,000 lb. The refrigeration problem was to handle one day's production plus heat transmission gains. The large storage room, 128 ft x 34 ft x 8 ft, is divided into four equal rooms with each able to store one day's production. First No. 1, then No. 2 and, on the third day, No. 3 room is loaded. On the fourth day, as No. 4 room is loaded, the load is removed from No. 1, where the product is down to temperature and ready for shipment.



Marine reduction gears are cut with exceptional precision in an air conditioned room. Once the tooth cutting operation is started, it must continue without stopping for several days and at constant temperature to insure the utmost accuracy. The slightest discrepancy would cause screeching and squealing when these gears turn at high speeds

The equipment consists of two 15 hp compressors, one evaporative condenser and four industrial refrigeration units. One compressor is connected to units in rooms Nos. 1 and 3, and the other connected to rooms Nos. 2 and 4. The control is handled with room thermostats; when cooling is required, the thermostat opens a solenoid valve, starts the evaporative condenser, the evaporative condenser pump, and the compressor. The unit blowers operate continuously.

Refrigerated Storage of Flying Suits — At flying fields, one of the principal refrigeration needs is for adequate protection of wool and fur flying suits. In order that these expensive items of clothing can be protected from damage from moths and from extreme conditions of temperature and relative humidity, they must be carefully stored. Due to their frequent use, chemical treatment is unsatisfactory and may cause damage to the furs.

The adult clothes moth, which we have all seen flying about, does not feed and normally lives from seven to 14 days. During this span of life, however, the female will lay from 100 to 150 eggs. These eggs are deposited on the wool fabric or among the hairs of the fur and, in from four to eight days in warmer weather to three weeks in cooler weather, will hatch into the destructive larva. This is the small white worm which feeds on the wool or fur where it hatched. As it feeds it spins a portable case which it moves from place to place. When full grown (this may require from 40 days to four years, depending upon temperature, humidity, and the nature of the food), it spins a cocoon within which it develops into the adult moth, thus completing the cycle.

In the larva stage, the only stage in which the moth causes damage, it is most susceptible to outside influences. Below 40 F, the larva becomes dormant over long periods of time, but when again subjected to higher temperatures, it resumes its foraging. At temperatures below 20 F it is killed.

Recognizing these facts, the "shock" system of refrigeration has come into prevalent use. The normal storage temperature is 35 to 40 F. The "shock" cycle is generally as follows:

For several days the storage room temperature is reduced to 15 F to kill any larva which may be feeding.

Then, by cutting off the refrigeration and introducing heat (usually from strip heaters in the supply duct or coil chamber), the storage room temperature is quickly raised to 50 F, where it is held for a *few hours only*. This will cause any surviving larva to again become active and will hatch out any likewise potentially dangerous eggs.

The temperature, after this period at 50 F, is again suddenly dropped to 15 F for a day to kill off the surviving larva and any larva newly hatched. After one day at 15 F, the temperature is brought back to the 35 or 40 F storage condition.

This entire procedure is repeated at regular intervals or, to prevent reinfestation, when any appreciable quantity of untreated articles of clothing is placed in the storage room.

Relative humidity should be high enough to prevent drying and cracking of the fur skin, but low enough to prevent mold or mildew. During the normal storage period with temperatures of 35 to 40, the relative humidity should be about 50 to 65 per cent.

Process Air Conditioning for Gear Cutting Rooms—The cutting of the huge marine propulsion gears produced by one company requires up to 17 days and, due to the extremely close tolerances involved, the temperature of the gear must not change during the cutting process. Likewise, the relative humidity must be kept low to prevent condensation on the gear and on the tools.

Around each of the 25 hobbing or cutting machines, enclosed rooms varying in size from 12 ft x 14 ft x 16 ft high to 32 ft x 38 ft x 18 ft high were constructed. The walls are of double steel with insulation between the inner and outer sheets.

Each of the rooms is served by an air conditioning system consisting of an air handling unit containing a cooling coil and a heating coil and a compressor, either a 3¾ hp or 5 hp. There are 13 evaporative condensers, each handling two condensing units.

From two to four men work in each room and outside air is introduced, mixed with room air, and brought through the air handling unit to provide a proper working atmosphere.

The internal design conditions are 75 F dry bulb, held within ±1 F, with the relative humidity approximately 60 per cent.

Testing and Storage of Parachutes and Parachute Materials—The enormous demand for parachutes of all types and sizes, coupled with our inability to obtain the silk from which 'chutes have in the past been made, has created an enormous market for domestic nylon and rayon producers. Each 'chute application calls for a specific type of material, for which rigid government specifications have been written; the materials must pass rigid tests to assure that the specifications are met.

A complete visual scrutiny of every yard of each 400 yd roll of material is made under strong fluorescent light by experienced examiners. Then from each roll a ½ yd sample is taken and, in special air conditioned laboratories, subjected to further tests. A permeability test establishes the resistance of the fabric to a metered stream of air forced through it; this quality affects the opening and maneuverability of the 'chute. The thickness of the material is measured to within one-ten thousandth of an inch and, for each sample, the weight in ounces per square yard is determined. Tests of the tensile strength of a 1 in. wide sample of the warp and filling are recorded on special charts for each roll. Fabric elongation of each sample under a given tension is recorded.

The tendency of fabrics to absorb moisture from the air and thereby undergo changes in physical properties makes necessary extremely close control of temperature and relative humidity in laboratories where the tests are made. Standard conditions for testing are 70 F dry bulb, ±2 F, and 65 per cent relative humidity, ±2 per cent. As a consequence the job must be carefully engineered from the standpoint of occupancy, heat leakage, infiltration, and outside air supply, and special controls and recording instruments must be used.

After the materials have been fabricated into completed 'chutes we encounter another refrigeration problem in the 'chute storage rooms. Usually, the storage rooms are held between 55 F dry bulb minimum and 50 per cent relative humidity in winter, and 90 F maximum and 50 per cent in summer. This, of course, requires only a balanced job of heating, humidification, and cooling.

Air Conditioning in the Abrasive Industry — In the manufacture of dressing wheels of the molded bakelite type air conditioning plays a very important part. When the abrasive elements are being mixed in their respective proportions to provide the desired abrasive qualities in the finished wheel, the proper moisture content of the various ingredient abrasives is essential. Wide variations in relative humidity affect the resultant mixture and bring about a lack of uniformity in the finished product. The viscosity of the bakelite fluid, likewise, will vary greatly under wide variations in temperature and cause a lack of uniformity in the bond of the finished abrasive mix. Also, the speed of drying of the finished wheel will vary as the room temperature and relative humidity vary.

In all three phases of production we see the same need for temperature and relative humidity control. Air conditioning provides the answer.

In the storage of ordinary sandpaper, control of relative humidity is important. If the relative humidity is too high the paper becomes moisture laden and deteriorates rapidly and, if the relative humidity is too low, the glue becomes dry and the abrasive substance becomes detached and is lost, seriously affecting the abrasive qualities of the sandpaper.

Air Conditioning in the Optical Industry—Probably no other industry has more aggravating problems in providing adequate protection against product contamination and damage during the many manufacturing processes than has the optical industry. From the grinding room through to final assembly, rigid employee rules and regulations are enforced and almost every known device employed to provide protection against such contamination and damage. Not the least of these devices is air conditioning.

Air borne dust is one of the chief enemies of a flawless product and must be eliminated through mechanical or electrical means.

Perspiration on the hands of the workers in the cementing and assembly rooms is a constant source of trouble.

In the grinding room, the air borne glass dust entrapped in underarm perspiration causes an irritating rash through which many man hours of time have been lost.

Face powder, rouge, and lipstick, unless banned by factory regulations, may cause countless rejects in the inspection, cementing, and assembly rooms through their contaminating and etching effect.

Wide variations in room temperature make definite predetermined settings of pitch and lap in the grinding and polishing rooms impossible, thereby slowing up production until compensating settings are made.

The consistency of the cement used in cementing the lenses varies with temperature and humidity, again hampering full speed production.

Lint and dust from clothing, while it can be controlled by the use of immaculate, lint free uniforms and cellophane jackets worn over ordinary clothing, is another hazard against which a guard must be kept.

In the storage of the finished lenses another problem is found. If the relative humidity is too high the paper in which the lenses are wrapped is affected and etching of the lens surfaces results.

We see, then, all through the processes three principal offenders — excessively high as well as widely varying temperatures, air borne dust, lint and abrasive particles, and uncontrolled relative humidities.

And, again, we find the solution to these problems in air conditioning. In some cases, the electrostatic air cleaner is used in conjunction with the air conditioning equipment, being installed just ahead of the filter section on the air handling unit.

"AIR CONDITION" THE AXIS WITH BOMBS —BUY BONDS

Practical Piping Problems

Importance of Maintenance

By Fred D. Mosher

NUMEROUS CHANGES have been made in plants of all kinds to take care of increased loads, to make room for new equipment and processes, and as a step toward improving efficiency. Many plants are now half old and half new, and many are still old with modern touches here and there. All these plants —whether they be producing war equipment or supplying heat for buildings—have one thing in common: piping.

Piping Improvements

Frequently, changes take place in plants over a long period of time. When changes are made it is not always practical to revamp the entire piping system, and as a result new systems are added to old. In the rush to increase capacity the possibilities of improving piping layouts should not be overlooked. The job of maintenance is to care for piping so that its function is carried out with efficiency, to prevent loss of service, and to maintain reliability. Piping maintenance may also fulfill another need—the need for improvement.

The maintenance department must be on the alert for changes which simplify piping, reduce maintenance work, and improve systems in general. Too often, discontinued piping is left to occupy space and to hide possibilities for improving the piping layout; once piping is discarded it should be taken down and reclaimed.

Drainage sometimes is a knotty problem and becomes further aggravated when the load is increased. Much can be done to improve drainage by relocating traps. Only in extreme cases should traps be placed in inaccessible places, or where frequent observations are not possible because of shafting, pulleys, and other apparatus. A trap should always be visible for inspection and should be arranged so that its functioning may be easily determined. Improvements which may be made include relocation, sight glasses to check drainage, and test valves to check operation.

The number of valves in a piping system should be kept to the necessary minimum. Relocation to more convenient places should be considered in the search for improvements.

The necessity for duplicate piping should be studied at intervals with a view to simplification. In older plants it is quite common to find duplicate or auxiliary lines to be used in case of failure of the main system; questioning will often bring out the fact that these duplicate lines are never used except when valves in the main system are given attention. It is true that parts of piping systems should have provisions for isolating so that ordinary maintenance work may be done without a plant shutdown, but it is also true that this can be accomplished in many plants without the use of duplicate lines.

Piping Inspection

How often piping inspections should be made must depend upon the kind of service, location of lines, simplicity or complication of the system, and fluids handled; systems which are being extended should be inspected frequently to note the effects of new conditions.

Piping inspections should be planned to cover all details of a system. Emphasis should be placed on efforts to simplify and improve. Piping diagrams often make improvements obvious, and any defects stand out.

During inspections the structure of the system should get due attention. The strength of supports and supporting structures should be noted. The lines should be checked for sagging, weakened hangers, contact of rollers, and evidence that they are free to move under pressure and temperature. The condition of expansion joints should be such that strains are not carried by the piping to connected apparatus, supporting buildings, or pressure vessels. It should be the duty of the piping inspector to note the condition of adjustable hangers and to observe whether or not ample support and slope are being maintained. Vibration must not be overlooked.

Insulation should get attention during inspections. Lines carrying cold water or other cold liquids are subject to external corrosion from atmospheric condensation. It is essential that waterproof materials protect these lines. Insulating materials must not be neglected since they conserve fuel and offer protection when piping carries high temperature fluids.

A leaking piping system is both wasteful and expensive. In addition to locating leaks, it should be the job of the piping inspector to determine the cause. Should provisions for expansion or supports be inadequate, leaks may occur at flanged joints. Leaks in themselves may not always be serious but they may cut flange faces, make insulation repairs expensive, and do damage to valves. Ample drainage of condensate must be provided; the piping should be adequately trapped; joints must be maintained in good alignment and re-gasketed at regular intervals. When leaks occur in the walls of piping it may mean that a defect in the metal is the cause; it may also mean that internal corrosion is wasting the metal to the danger point.

Valve Wear

The purpose of valve inspection should be to determine the actual condition of the valves with regard to normal wear and tear. Valves are subject to constant wear on seats, disks, and stems, with the seats and disks bearing the brunt of abuse. Arrangements should be made to inspect the internal parts of all valves. Experience shows that regular inspection of valves may forestall expensive replacements or repairs, for once the cutting or wearing process begins the internal parts may rapidly deteriorate to the point of destruction. Stems of valves usually become worn because packing is neglected or because of improper handling. The inspector should tell from observance of leaks or the ease with which a valve operates whether or not it requires maintenance. Wear and tear will result rapidly from misapplied valves. It is standard practice to provide gate valves for draining and full flow while globe valves are used in throttling service. Where changes are made in piping systems it may come about that the functions of valves are switched, and it is the responsibility of the inspector to check such defects.

Steam trap inspection should be done at the time the connecting piping is examined. The experienced inspector can determine partly by touch the operation of a steam trap. Gage glasses are also an aid to trap inspection. When apparatus is relocated it is important that traps be maintained in their proper position with relation to the equipment.

Regular Maintenance

Maintenance work on piping systems should be pointed at the removal of conditions which might cause outages, failures, and time consuming repairs. This means that all maintenance should be preventive. For example, insulating coverings are subject to deterioration from roof leaks and it is important to prevent damage from this source. The danger of having insulation damaged by ladders and the weight of plant personnel may be eliminated by providing adequate platforms and other means of getting at valves in the system. Wet spots on coverings should be traced to their sources and corrections made.

How to Charge Tenants for *Extra Hour Heating* in Multiple Occupancy Buildings

R. E. Hieronymus Explains a Method of Billing for Heat Furnished During Long Wartime Hours

SUMMARY—For a building to furnish a limited amount of Sunday or extra hour heat in normal times is one thing; to "donate" even more of this extra service in wartime, when fuels are restricted and expenses are increasing, is another. How to determine a basis for charging for the extra heat which will be fair to both the tenant and the building management, and which can be easily explained to the tenant, is our subject here . . . Mr. Hieronymus, general superintendent of Aldis & Co., large building management firm, is a member of HPAC's board of consulting & contributing editors

THE ARTICLE by P. B. Jameson, How to Determine Cost of Overtime Heat in Industrial Buildings, in the February HPAC, set forth a very practical method of the computation and the proper distribution of the cost of extra night and weekend heating in such buildings, where it has not customarily been furnished.

The method proposed by Mr. Jameson is admirable for such a case as he described; namely, a building where the occupants are few in number, where all of them now require extra heat, and where each is willing to pay his reasonable share of the extra cost. It offers, further, a guide to the management in determining and apportioning such costs in other types of properties where the extra service is not needed by all the occupants but by only a part of them.

In practice, when the extra heat is needed (or, at least, admittedly needed) by only a few of the occupants, there may be difficulty in assessing and recovering the extra costs involved. This is frequently the case in multiple occupancy office and loft buildings, and this problem has now come to the front in such properties also. Particularly is this a knotty problem in a building of miscellaneous occupancy which is not zoned, and where, to heat one or more floors or offices, the whole building has to be heated. In such a building there will likely be some tenants who, in view of the known requirements of certain other tenants, will hope and expect to take advantage of this extra service without being specifically charged for it.

The present actual restrictions on oil fuel, and the current request of the Office of War Information (poster No. 12) *for all buildings to conserve fuel, because of defense transportation limitations,* plus the increased cost of all fuels, plus the rising cost of building operation, plus the patriotic motive to practice economy in the use of all supplies and materials, have caused many owners and managers of commercial real estate to tighten their belts and endeavor to cut down the fuel consumption of their buildings as much as possible.

Heating "Habits" of a Building

Here come to light the "habits" of a building. In Chicago, with which the author is particularly familiar, the standard form of office and loft building lease stipulates:

"No. 2. SERVICE. The lessor shall provide: (b) Heat daily from 8:00 a.m. to 6:00 p.m., Sundays and holidays excepted, whenever heat shall, in the lessor's judgment, be required for comfortable occupation and use of the premises." (From Chicago office lease form b.)

All the leases in any particular building contain this provision. In addition, the health section of the city code imposes certain requirements of minimum temperatures for certain hours, but these provisions need not be recited since they seldom have any practical bearing on the problem now under consideration. The situation is similar in other cities, for in many the standard form of lease in general use contains provisions with respect to heating service similar to those used in Chicago.

Notwithstanding this formal stipulation concerning heating service, it has been customary in many Chicago buildings for a number of years to supply some heat on Sundays, partly (and particularly in zero weather) to avoid the possibility of frozen plumbing, partly to make it easier to get the temperature of the building up to normal again on Monday morning, and in many cases (in mild as well as severe weather) just because there are a number of the tenants who by habit or necessity come down to the building on Sunday and expect to find it tolerably warm.

For example, in one Chicago office building in the central business district in which the weekday population is around 3200, the number of persons coming to their offices on Sunday averages around 100.

Requests for Extra Heat

Now, to furnish even a limited amount of Sunday heat in *normal* times, whether or not the weather actually makes it necessary, is one thing. But to "donate" even more of this extra service not contracted for in wartime when fuels are restricted and all expenses are increasing is

The technical committee of the Chicago Building Owners and Managers Association has suggested the wording below for a revised version of the OWI's poster No. 12

A Message from the Government

HELP CONSERVE FUEL

1. **Keep windows closed as much as possible—turn off radiators—or thermostats—to prevent waste.**
2. **Don't request heat outside of regular business hours.**
3. **If your building is on restricted fuel, cooperate with the management by accepting reduced standards of heating.**
4. **Use less hot water.**
5. **Turn out lights when not required.**

Saving fuel saves transportation for America's war effort

(Adapted from Poster No. 12 issued by OWI)

another. For along with the changed complexion of the economic picture it is true that in some buildings more and more of the tenants want the extra hour heating. This is accounted for partly by increased business in the case of certain tenants, such as rush orders occasioned by the war, partly by certain offices and establishments working evening and Sunday hours to compensate for loss of personnel due to war conditions, and partly, possibly, by other causes.

Here the manager is faced with a dilemma. He encounters increased demands for this extra service which he never was really obligated to furnish in the first place, and, aside from the physical restrictions in the fuel which he is encountering, or may soon experience, he is less able financially to furnish such service.

Other complications may be evident. His tenants may demand that he furnish this extra service without cost "to help the war effort", but his government has made of him a direct request to conserve fuel (poster No. 12 again) as a patriotic measure.

How Buildings Charge for Extra Heat

To discourage extra hour heating and to recover the approximate costs thereof when it is not possible to decline to furnish it (and, again, not referring to Mr. Jameson's simple case, but to the building where the demands for extra heating are not universal, nor regular, nor constant among the occupants), several Chicago buildings with miscellaneous occupancy are charging for this service, and one of them uses the following system. The case described is for a building where all the space is on one feed system; where a building is zoned into two or more sections, the costs may be prorated according to the areas necessarily heated and the charges made accordingly.

A tenant who knows the heating "habits" of the building (or who requires extra hour heating even though he does not know the conditions prevailing outside of the regular lease hours), requests extra heat at night or on Sunday. The manager or superintendent tells the tenant that such extra heat may be forthcoming but that he will have to sign a request containing an agreement that he (the tenant) will pay the extra cost.

Feeling that the average tenant will want to know definitely and in advance what the charge is going to be, and that he will be suspicious of any computation which involves degree days or other mysterious allowances for the kind of weather then current, the manager is ready for the question because he has already figured out the average cost per hour of furnishing extra steam service and he can tell the requesting tenant what the charges will be.

The following study, which is the instruction memo for an actual case, is typical of the procedure necessary to put extra heating on this kind of a basis. It should be realized that this computation, and the charging for extra heat on this basis, are not a refined method which assuredly will regain for the management the total actual cost of furnishing any given amount of extra heat. Rather, it is a method of discouraging the requests for extra hour heating and recapturing the approximate costs of furnishing it.

This simple method of obtaining compensation for extra heat obviates a great deal of complication. Sometimes the fireman labor required will already be on duty in the building, and sometimes the fireman will have to be asked to stay extra hours with additional pay. It appears, however, that this manner of charging for extra heat, while not a refined method, will substantially recover the additional costs incurred.

The computations may be varied to suit the conditions in any specific building, attention being paid to changes in wages, manner of prorating the salaries of regular boiler room employees, etc. The normal hours heat is "on" will need to be computed or estimated, taking into account the normal schedule of any particular building and also the climate.

The standard turning on and off schedule for this particular building, from which the amount of extra hour heating is determined, is reproduced herewith. This schedule will, of course, vary with different buildings, but it is well to relate the extra heating to a regular instruction sheet which can be exhibited to the tenant so that he can be assured that advantage is not being taken of his special need for extra service.

Instructions on Charging for Extra Heat

To the superintendent of the building:

The basis for charging, and the manner of handling requests for extra heat, are as follows:

It will be impractical to determine in advance the extra cost on specific days, so we have therefore determined the average cost of fuel and labor per hour when the steam heat is "on", and the tenants will be charged for extra hour heating at this rate, regardless of the outside temperature during the hours when the extra service is furnished.

Determination of Cost:

Average cost of fuel during last three heating seasons	$ 9197
Increase in fuel cost this year.	540
Expected cost of fuel this year.	$ 9737
Annual cost of engineers' and firemen's labor, average of last three years	$12054
Less three-fourths of shift engineers' salaries, regularly on duty anyway	8420
Firemen's salaries and prorated one-fourth of engineers' salaries chargeable to production of steam	$ 3634
Expected cost of fuel this year plus firemen's and prorated engineers' salaries, $9737+ $3634	$13371
(During a normal heating season the steam is actually turned on a total of 2440 hr, which averages about 10 hr per day for the normal heating season of 240 days.)	
Average cost of fuel and boiler room labor per hour steam is "on"=$13371÷2440	$ 5.48

Any tenant requesting extra hour evening heating (by which is meant a higher temperature than he may otherwise encounter in his space) must request it before 5 o'clock in the afternoon; or if he is to require extra heat on Sunday, he must request it before 5 p.m. on the Saturday before.

He will be furnished the requested service provided he signs a slip requesting the service and accepting the billing (with the rent, in advance of the first of the following month) at the rate of $5.48 per hr for the extra hours the steam is left on for his accommodation.

The tenant agrees that he will notify the night engineer (or else specify in advance) when the steam may be turned off; otherwise he will be charged for extra heating throughout the night.

To compute the extra charge, you will note the time the tenant has the steam turned off (see engineer's log book), and referring to the customary turning on and off schedule, you will determine the extra hours the steam was left on.

Please note the extra hours on the slip the tenant has signed, also the amount of the charge for that day, and on the 25th of the month turn in all such slips to the main office, from where the accounting department will render the billing on the last day of the month.

Any tenant requiring extra heat regularly for an extended period need not be required to sign a slip for each day; merely have him sign the second part of the slip, and then you will furnish heat as requested, keeping a record of such extra heat by days and hours; and on the 25th of the month report the extra charges for the preceding 30 day period.

It will naturally happen that other tenants who did not request the steam

service may occasionally avail themselves of the fact that the heat is turned on, but it is impractical to distribute the charge among all those benefiting by it. Therefore the charge will be made to the *first person requesting the steam service.* Should one tenant request extra steam until 10:00 p.m., say, and subsequently some other tenant should request the service to midnight, tenant No. 1 will be billed for the service up to 10:00 p.m. and tenant No. 2 will be billed for the service from 10:00 to midnight.

Sunday Heating

During the past few years, we have arrived at a schedule of partial heating for Sunday, according to which the engineer turns the heat on and off. For the present, tenants availing themselves of this regular partial Sunday schedule will not be billed therefor. However, if any tenant wishes heat before or beyond the hours of the regular Sunday schedule he will be billed therefor at the same rate per hour as for week days.

A tenant wanting extra hour steam but who wishes to avoid paying for it may approach you late in the afternoon to learn if someone else has already requested evening or Sunday heat. Please decline to tell him, stating that you are instructed not to give out this information. However, you may tell him what the regular schedule is, and explain that limited heat is furnished on Sunday anyway. If you encounter a tenant who gets tough in his efforts to be a "free rider", please endeavor to explain the system of making charges and let him decide whether or not he wishes to request it. If he objects that it is not fair to charge him for evening heat when he is sure others will have the benefit of it, or if he asks why he should be charged for heating the whole building when he occupies only a small part of it, be diplomatic and polite, and as firm as you can, bearing in mind the necessity of not incurring the serious enmity of the tenant. Explain to him that here we are, with a one zone building, where to heat *any office* we have to heat the entire building, and that it just isn't practical to prorate the cost of extra evening heat among all the people who may benefit by it on any particular evening. Lead him to see that if he stayed down some evening, without having himself asked for extra heat, he would probably resent receiving a bill for it *when someone else had requested it*, and try to convince him of the reasonableness of our policy.

Failing in this effort, will you please take up the problem with the undersigned, and the management will interview the tenant, taking special pains to convince him of the reasonableness of this procedure.

Quoted below is the standard form which you will require the tenant to sign before extra hour heat will be furnished.

Heating Steam Turning On and Off Schedule for "Star" Building

Outdoor Temperature, F	Weekdays Steam On	Weekdays Steam Off	Sundays and Holidays Steam On	Sundays and Holidays Steam Off
—10	Steam on all night		Steam on all night	
— 5	2:00 a.m.	11:00 p.m.	2:30 a.m.	10:00 p.m.
0	3:15 a.m.	8:00 p.m.	4:00 a.m.	8:00 p.m.
5	3:40 a.m.	5:50 p.m.	6:00 a.m.	5:00 p.m.
10	4:00 a.m.	5:40 p.m.	7:00 a.m.	4:00 p.m.
15	4:30 a.m.	5:30 p.m.	8:00 a.m.	3:30 p.m.
20	4:55 a.m.	5:20 p.m.	8:30 a.m.	3:00 p.m.
25	5:20 a.m.	5:10 p.m.	8:30 a.m.	3:00 p.m.
30	5:45 a.m.	5:00 p.m.	8:30 a.m.	2:00 p.m.
35	6:00 a.m.	4:50 p.m.	9:00 a.m.	2:00 p.m.
40	6:30 a.m.	4:30 p.m.	9:00 a.m.	2:00 p.m.
45	7:00 a.m.	4:30 p.m.	No steam except by special authorization.	
50	7:25 a.m.	4:00 p.m.		
55	7:45 a.m.	4:00 p.m.		
60	8:00 a.m.	4:00 p.m.		
65	No steam except in special circumstances.			

On Monday a.m., and after holidays, turn steam on one hour earlier.

Note to engineers: No steam to be furnished, other than the above schedule, unless authorized by this office, or required by tenants who have signed a formal request.—"Acme & Co.," Agents.

REQUEST FOR EXTRA HEAT

Form 1. Date———— 19——

I, the undersigned tenant of the "Star" building, herewith request special heating service outside of normal business hours on ———— 19——, and if this service is furnished I agree to pay for same, upon presentation of bill, at the rate of $5.48 per hr.

I agree to notify the night superintendent or the night engineer when the heat is no longer needed, and you may bill me up to the time of such notification.

(Signed)————————

Room———

Form 2.

Until further notice, please furnish evening heat regularly each weekday evening, continuously after 6 p.m. until notified to turn it off.

Also, please furnish heat regularly on Sundays from ——— m., until notified to turn it off.

I agree to notify the person in charge each day or night when the heat is no longer needed, and agree, at the end of the month, to pay for all such extra heat furnished at the rate of $5.48 per hr.

(Signed)————————

Room———

Please have the tenant sign the request, form 1 or form 2, whichever covers the particular case.

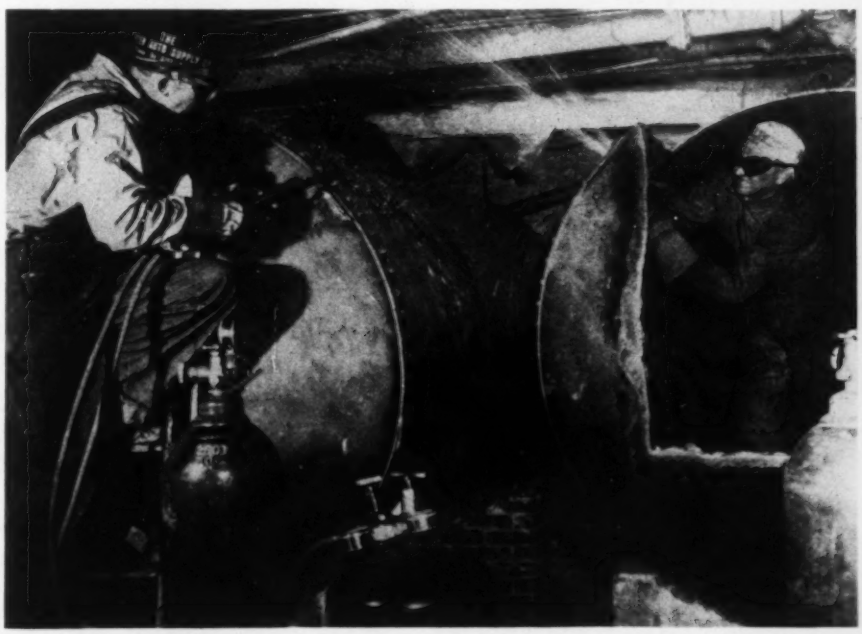
Be governed by these instructions until further notice.

"Acme & Co.", Agents
by the general superintendent

CARRYING THE TORCH FOR SCRAP

These workmen cut up aged tanks which served the hydraulic elevator system of the old Metropole hotel in Denver. Similar outmoded tanks in mills and factories can add to the tank armies needed to swamp the Nazis and Japs

[Write the Business Press Industrial Scrap Committee, Room 3303, Empire State Bldg., New York City, for the "Primer of Industrial Scrap", which will help you tackle the salvage problem.]



Handling Small Water Quantities with

the Siphon or Ejector Pump

Removal of Condensate from Small Cooling Coils – By F. F. Stevenson

SUMMARY—The problem of condensate removal from the drain pans of floor coolers sometimes presents difficulties; one solution, which may also be employed in other situations where small water quantities must be handled, involves the use of the siphon or venturi ejector pump. This device depends upon the vacuum created when water flows through a venturi section and is sprayed out of an expanding nozzle, to pull other water through an inlet line connected to the point where the vacuum occurs...Mr. Stevenson, formerly with J. P. Baldwin Co. and now a supervising engineer in war work, discusses the problem and the use of the siphon pump, and gives practical recommendations on the piping layout, necessary valves, etc.

AN AGGRAVATING and yet essential problem with small air cooling installations, particularly where small floor type coolers are involved, is the removal of the condensation created by the dehumidifying action of the cooling coils. Many a layout man has discovered to his dismay that the cost of a suitable and workmanlike job of condensate removal is all out of proportion to the overall cost of the installation.

Of course, in most applications the level of the drip pan in the cooling unit is high enough and the level of the open drain connection is low enough so that no trouble is encountered. On the other hand, we sometimes have to deal with a drip pan that is practically at floor level, several walls or partitions inflict themselves between the cooler and the open drain, and the latter—worst of all—is several feet above the level of the drip pan.

Before starting to tear his hair and to think of condensate pumps, siphon pumps, etc., the layout man may do well to explore all the possibilities before deciding to spend too much money. By going through the flooring, it may be easy to empty into a drain line on the ceiling or wall below. Permission will be necessary here, if someone else occupies these premises.

The author knows of several cases where floor coolers were installed in the offices of industrial firms. The offices were on the ground floor, and it was a simple matter to cut the wall, run a ⅜ in. condensate line through, and let the condensate help water the grass outside.

Also, in the case of coolers in modern office buildings, the condensate line may be run through the exterior wall, the tubing curved a little to direct the water flow so that it impinges squarely on the wall surface, and the water simply trickles down the wall. Two or three floors down, there will be no sign of moisture. Of course, permission from the proper authorities should be obtained before proceeding with such work.

Naturally, all installations do not present such easy outs; it may be, for example, that the only open drain is several feet above the condensate pan —and what are you going to do about it?

A Pump Is the Answer

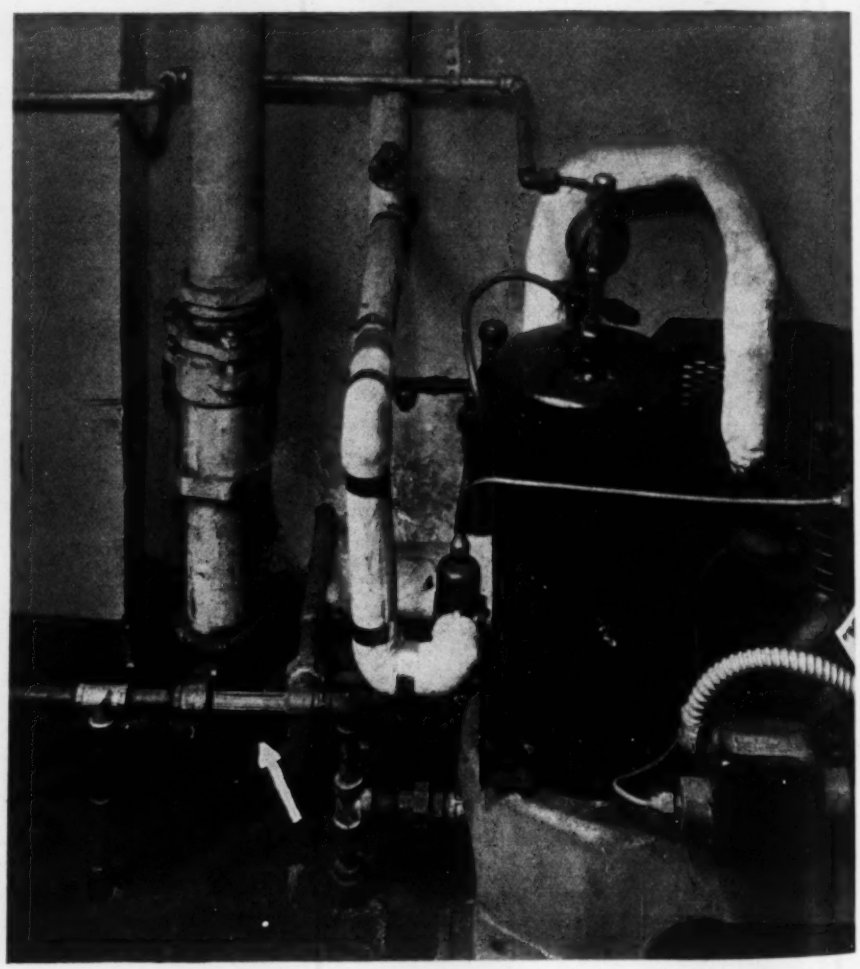
The only answer seems to be a pump. Of course, there are pumps and pumps. There are many small types used in heating work which will do an admirable job of pulling the water out of the drain pan and up into the sewer connection. The trouble is that practically all of these have a capacity many times the requirements, in respect to the amount of water condensing on the coils of a floor cooler or two. Also, a pump with a motor, no matter how small, will need attention at some time or another.

But there is another type of pump available which is especially useful for such work—the siphon or venturi ejector. It is placed in the waste water line of the refrigeration condenser. Here is a little gadget which is inexpensive, has no moving parts, and is capable—under the right conditions—of pulling water up a considerable distance.

Use of the Siphon Pump

The siphon pump is in the form of a tee with a venturi tube or nozzle in

The arrow points to the venturi pump, which is in the condenser waste water line



the longer section. Water is brought into this section and forced through the venturi tube. In passing through the smaller part of the venturi tube, a high velocity is developed. Then the water is sprayed out of the expanding nozzle, and this action creates a partial vacuum in the chamber just after the nozzle. An inlet line is located at this point, and the partial vacuum and the entrainment effect in the chamber will pull up any water or liquid in this line a considerable distance. This is the pump action. There are no moving parts; check valves may be necessary in the lines, however, and these must be kept free of dirt to insure tight closure.

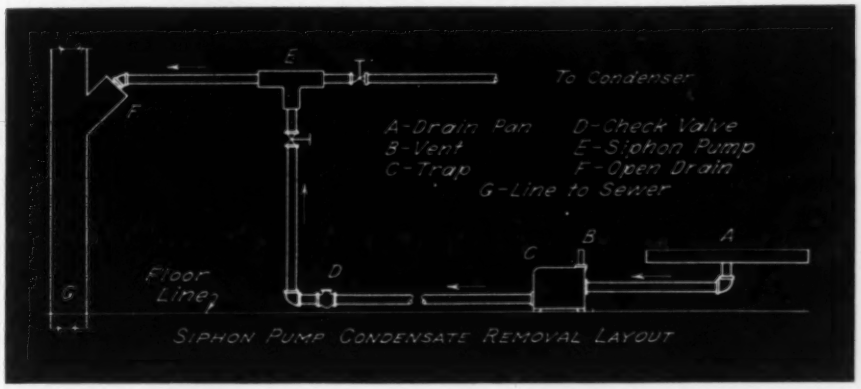
Readers may be interested in a little cooling system where such a device was used effectively. The system consists of a large floor type room cooler, with a condensate drain pan only a couple of inches above the floor level. The condensing unit is in another room about 15 ft away. The closest drain is also in this room, and construction is such that it was necessary to tap into a vertical sewer line connection about 4 ft above the floor level.

The first thing done was to raise the cooling cabinet up about 5 in. by placing blocks at the four corners; these were finished to match the cabinet and their appearance was not unsightly. A ⅜ in. drain pipe was run from the drain hole in the pan into a ball float trap, placed at the floor level. The flow from pan to trap is by gravity, for there are a few inches of head between the drain pan and the intake of the trap. The trap is vented to the atmosphere.

Condensate water flows from the drain pan into the trap and when a certain level is reached, the ball float acts on a valve and the contents of the trap are emptied into the outlet line, which is a horizontal ¼ in pipe. The condenser water waste line was run up to a height corresponding to the drain and the siphon pump was installed at this point in a horizontal position. The condensate line was then connected to the pump.

Operation of Venturi

When condenser waste water is flowing, a partial vacuum is created in the pump chamber and there is no difficulty in pulling up the condensate water a distance of several feet. As there is a considerable pressure loss across the ejector pump, there must be sufficient water pressure in the line ahead of the pump in order to create the high velocity required through the venturi. As previously stated, the pump, in this instance, is at the condenser and there is a horizontal run of a number of feet to the open drain. If convenient, it is much better to have the pump as close to the drain as possible, instead of at the condenser. This is because the pressure loss in the line between the pump and the open drain should be kept as low as possible. The lower this loss, the more efficient is the operation of the pump, because of the greater vacuum that can be maintained in the pump vacuum chamber. However, with a vertical lift of only a few feet, this may not be critical.



Remember, one of the cardinal principles of a venturi is that the velocity pressure of the water flowing through the tube must be greater than the pressure losses in the line after the nozzle. The losses are the nozzle outlet loss, the impact loss when condensate water meets the condenser water flow, the friction and dynamic loss in the line after the ejector nozzle, and finally the outlet loss at the open drain. When the water leaves the vacuum chamber, part of the velocity pressure is converted into static pressure to overcome these losses. Whenever the above mentioned losses are greater than the venturi velocity pressure, the water in the chamber will have a positive static pressure and if this is the case there will be positive pressure in the vacuum chamber of the pump and it will cease to function.

Check Valve Necessary

An important thing to consider about such an installation is the fact that when the compressor stops, the automatic water valve slowly throttles. When the water pressure and volume are reduced and velocity through the venturi tube is lowered to a certain point, the vacuum and entrainment effect ceases and water in the condensate line is no longer pulled up into the condenser waste line. In fact, when the vacuum is destroyed, the water in the vertical condensate line will fall back. Also, there is the possibility that the condenser waste water will flow into the condensate line, instead of through the line leading to the drain. Therefore, a check valve should be placed in the condensate line.

This will stop such a flow, unless the check valve becomes clogged. The condenser waste water in this case might continue through the condensate line until it reaches the trap. A sharp lowering of condenser water temperature would also cause the water valve to throttle and it would be well to check this possibility. If there is a likelihood of this happening, it would be best to use the so-called "cycling" type of water valve, which is either closed or full open, or one with a solenoid pilot which gives similar operation.

Some erection men use a water strainer instead of a trap, which seems to work all right in a number of cases. One of the chief functions of the trap or strainer is to prevent the sucking noise caused by the pumping effect of the venturi when there is little water in the drain pan. This might occur frequently and is objectionable.

Water Pressure

Also, do not consider this arrangement unless at least 25 to 30 psi water pressure is available at the inlet of the automatic water regulating valve. The pressure loss through valve and condenser might well be 10 psi or more and the loss through the ejector amounts to another 10 or 15 psi; this leaves but a small safety margin for line resistance after the pump.

The greater the volume of water flowing through a venturi pump of a given size, the greater the pressure loss through the pump and the greater the vacuum effect in the pump chamber. Therefore, the larger the condensing unit used, with its greater water flow, the greater the vertical lift possible. With volumes of water from 100 to 180 gph, which would be about the average for 1 and 2 hp machines, it is possible to obtain vertical lifts of 10 to 12 ft. Be sure that enough water pressure is available for the longer lifts, for pressure loss across the pump increases sharply with greater water flow.

When one condensing unit handles two coolers, one pump may be used if it pulls sufficient vacuum to handle two condensate lines. Or two pumps may be used, the condenser water waste line being constructed in two sections of pipe at this point and the pumps placed in parallel.

Hand valves may be placed on the condensate side and on the upstream side of the pump.

TURN THE HEAT ON THE AXIS — BUY BONDS

Government Speaker Advises Real Estate Men on

Coal Purchase and Storage

IT WILL be necessary for consumers to take the following steps in order to assure the adequacy of the coal supply, according to Thomas J. Thomas, Associate Deputy Solid Fuels Coordinator for War, in an address last month before the Institute of Real Estate Management:

1) Place orders now for your entire year's supply of coal.

2) Accept delivery as rapidly as your supplier can make it available to you, and store it. Build up your storage to an entire season's supply, if you can, and maintain it that way as long as the coal can be supplied by continuing to buy more coal as you consume it.

3) Give your supplier the greatest amount of latitude possible as to the kind, grade, or size of coal and as to delivery schedules. However, make every effort to get your entire next winter's supply in hand during the warm months, and the earlier the better.

"I assume that most of you do not have railroad siding facilities which would permit you to receive coal in carload lots," Mr. Thomas said. "In that event, you will probably buy your coal through local retail dealers. Come to a thorough understanding with your dealer on all the details of your coal supply just as soon as possible. Complete the arrangements for the financing of the purchase, for its shipment and delivery, and for the storage of the coal.

"Because of the shortages of gasoline and of rubber, there now are restrictions on truck operations, which limit their use more than in the past. This must enter into your coal calculations this year and it is important that you make sure that trucking equipment will be available when it is needed for delivery of the coal to the point of storage or to haul it from storage to the place of consumption, if it is stored away from the place of consumption.

Storage Space for Coal

"Each of you will probably be faced with different problems. Some buildings may have ample bin capacity to hold the entire season's supply. Others may have only capacity for part of the season. Bins in buildings originally designed for coal but later converted to another fuel can possibly be changed back by the removal of partitions and other reconstruction. Some buildings, never designed for coal, may have no storage space at all, or perhaps some slight structural changes will give space.

"If the bins of your buildings are not large enough, or cannot be enlarged to hold the entire season's supply of coal, it is up to you to use your ingenuity to find another place to store the coal in excess of their capacity.

"One of the large hotels in Washington adopted the novel expedient last summer of piling up some 2000 tons of coal against the outside of the building. It was fenced in, possibly in an effort at concealment. But I rather think that the fact that the pile is visible is a good advertisement for the hotel. It must give its guests the assurance that they will not be cold.

"A number of other big buildings including some well known institutions in various parts of the country, have also disregarded appearances and have built outdoor storage piles on land adjoining their plants.

"Coal does not have to be under cover and it does not lose heating value by exposure to the weather. However, with some low rank coals, weathering may produce a degradation in size but this is not especially serious under ordinary conditions.

"If you have some vacant land available for storage close to the building where the coal will be burned, use it. Perhaps there is available vacant property nearby which can be leased, or your dealer may be able to help you make suitable arrangements. Discuss these possibilities thoroughly with him and come to a definite agreement which will assure adequate protection.

"Another possibility for the handling of this extra coal storage is in a partnership arrangement. A cooperative storage plan might be instituted through your real estate organization, through your hotel, apartment house, or other trade organization. A group of hotels, for instance, might unite in leasing property from a railroad company along its right of way for the joint storage of large quantities of coal. This arrangement would probably reduce the cost of protecting and handling the coal for the individual members of the group.

Planning to Convert

"In discussing storage and storage problems I am addressing not only the regular users of coal and those who have already converted to coal from another fuel but all who intend to convert. It is just as important for those who are planning conversion to make all arrangements for their coal supply, as for those who have already switched.

"If your conversion is still in the planning stage, complete details of securing your coal supply before you start installation of conversion equipment. Be sure that you will be able to obtain the kind of coal required for the equipment you are considering installing.

"All coals are not alike. There are high and low volatile bituminous coals and coals of various sizes and grades. Certain coals are so much in demand that already they are almost unobtainable.

"In selecting conversion equipment, the greatest fuel security will lie in obtaining the type that will burn both high and low quality coals, and particularly that which will burn the smaller, so-called "industrial" sizes of anthracite or bituminous. You may not always be able to get readily the particular coal you would prefer, and the more elasticity you can give your producer or dealer the better will be your protection. Take every precaution that you can against selecting equipment that requires a coal that is limited in supply.

"For the rest of this winter the supply of anthracite for persons who expect to convert from fuel oil will be extremely tight and limited to small sizes, such as rice and buckwheat, although bituminous coal should be available.

"Use of mixtures of fine-sized anthracite (rice or buckwheat) with some of the small-sized bituminous coals might be worthy of consideration by some of you. Where this is found practical, it is said to tend to reduce smoke problems and improve combustion.

"For equipment already installed, give your dealer as much latitude as possible in your specifications. As long as you can get a kind and size of coal which will work efficiently in your plant, you will be able to keep warm. Substitutions are often possible.

"I do not believe that it is possible to overstress the importance of buying and storing your coal when it can be produced and moved readily. Early in 1942, the Office of Solid Fuels Coordinator for War began advising consumers to buy and store coal. Many of those who followed our advice have been thankful this winter that they had enough on hand. The anthracite strike brought home to consumers of hard coal the many possibilities for interruption of the coal supply in wartime.

"If consumers take these simple precautions themselves, they will not only protect themselves but make a big contribution to the war."

Heating · Piping and Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

Proceedings of Annual Meeting 1943

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Hotel Gibson, Cincinnati, Ohio
January 25-27, 1943

THE 49TH Annual Meeting of the Society concluded its two-day session with a registration of 380, with a variety of subjects of vital interest to engineers presented at its technical sessions. Members registered from 29 states and three provinces of Canada.

First Session—Monday, January 25, 9:30 A. M.

The first technical session was opened with First Vice-Pres. M. F. Blankin presiding in the absence of Pres. E. O. Eastwood, Seattle, Wash. Albert Buenger, General Chairman of the Committee on Arrangements of the Cincinnati Chapter, welcomed the members and guests to Cincinnati, and introduced Col. Charles O. Sherrill, City Manager of Cincinnati, who also extended a word of welcome on behalf of the city government and the City of Cincinnati. Colonel Sherrill spoke in detail on the engineers' work, stating that they are a rather peculiar breed of people. He paid tribute to the engineers and contrasted them with those engaged in other lines of effort. He pointed out that engineers have the happy faculty of taking a lot of facts scattered around, picking them up, sorting them, working over them, getting the meat out of them, and then coming to a conclusion based on those facts. He then referred to a celebrated engineer with the TVA, who delivered an address in Cincinnati recently, in which he pointed out the importance of arriving at a sound conclusion as to what the basic facts are.

In conclusion he complimented the Society in holding the meeting at this time, and expressed his opinion that it was the duty of national organizations to carry on during wartime, and keep abreast with developments, so that they will be prepared not only for what takes place now but what will take place in the not too distant future, when this war is won by the Allies.

Mr. Blankin responded briefly to Colonel Sherrill's remarks, and then expressed regret that Professor Eastwood could not be at the meeting; on advice from his physician he was forced to remain in Seattle. Mr. Blankin then read the President's report.

President's Report

There has been no year in history comparable to the year 1942, either nationally or internationally, and as long as the world conflict continues perhaps each succeeding year at its conclusion may be similarly designated as affecting our liberty and our civilization. The influence of war has already been felt in engineering and in engineering societies. Practically every activity of war, whether manufacturing, transportation, combat, construction, or destruction, is of an engineering nature.

This influence is reflected in the activities of the American Society of Heating and Ventilating Engineers. Our members are serving in government work and in the Army and Navy. Our research activities have been influenced along lines of service in war. These activities have kept pace with growth of research work throughout the world. We have always recognized the importance of dissemination of knowledge as a function of the Society, but we have largely confined this dissemination to ourselves and the engineering profession. In times like the present we realize that our responsibilities should include the general public. Comfort, efficiency, economy, and health, under rationing conditions, are of great importance to the public.

The influence of the war is expected to be perpetual and will be felt socially, politically, philosophically, and perhaps religiously. Never in history has science ever played so important a part as in the present war, and in the future science should play a much more important part in the educational system. For generations the stamp of an educated man has been impracticability, and in our universities this idea persists in the classical divisions. Scientists have no quarrel with the man who revels in poetry, literature, music, and art. Indeed, they encourage these interests, and the scientist frequently leaves his footprints when he has made excursions into these fields.

During the past year, we have followed the usual program with due consideration for the prevailing conditions. Our Chairman of the Committee on Research will report covering the work of the Research Laboratory and cooperative institutional research. There are other Standing and Spe-

E. O. Eastwood, Seattle, Wash.
President—1942

cial Committees at work, and, although reports may not be submitted formally, the work of these committees advances the prestige and usefulness of the Society. The accomplishments of this Society do not reflect the deeds of one man. The Society lives and goes forward because of the self-sacrificing work of its individual members. National demands and priorities account for change in occupation and, in many instances, for dissolution of businesses of some of our members.

Membership in any society is an important consideration. I acknowledge the valuable service contributed in that connection by W. A. Russell. Similarly, I recognize the valuable services of J. F. Collins, Jr., Chairman of the Committee on Chapter Relations; of A. J. Offner, Chairman of the Guide Publication Committee; of E. N. McDonnell, Finance; F. C. McIntosh, Research; A. P. Kratz, Meetings; W. L. Fleisher, Executive; and S. H. Downs, Standards; and to the personnel of all these committees. I wish to pay tribute to the War Service Committee, under the direction of Dr. B. M. Woods, and to the chairmen and personnel of the many special committees, and to all the members of Council for indispensable cooperation.

As we start another fiscal year of our Society, we realize that the past furnishes only a foundation upon which to build the future, no matter what the accomplishments of the past may be. The future challenges the membership to a rededication to service. May the same spirit of goodwill and sacrifice continue to build a better, stronger, and more useful organization.

—E. O. EASTWOOD

January 25, 1943

Council Report

Five meetings of the Council were held since the last Annual Meeting at Philadelphia.

At the organization meeting January 29, 1942, President E. O. Eastwood announced his Committee appointments which were confirmed by the Council. A budget for 1942 was adopted calling for the expenditure of $80,850 and an estimated income of the same amount, representing a reduction of 19 per cent compared with the previous year. Depositories for Society funds were selected and a certified public accountant to audit the Society's books was appointed.

Announcement of the appointment of A. V. Hutchinson as Secretary, John James as Technical Secretary, and F. C. Houghten as Director of the Research Laboratory was made.

To assist in the emergency created by war, the Research facilities of the Society were offered to the people of the United States through its Government.

The second meeting of the Council was also held in Philadelphia, but due to the illness of President Eastwood, M. F. Blankin, First Vice-President, conducted the meeting.

The invitation of Cincinnati Chapter was accepted for the 49th Annual Meeting.

An analysis of membership indicated a total of 3107 on the rolls and a review of the financial condition of the Society for the first quarter showed that collections were higher than anticipated.

Because of Dr. F. C. Houghten's call to service in the Navy as Lieutenant-Commander in the reserve, it was considered advisable to provide for an Acting Director and such other administrative readjustments as would meet the demands of a wartime program.

At the St. Paul Meeting of the Council, the Membership Committee was authorized to conduct a special campaign and the Finance Committee submitted an amended budget providing for an anticipated income of $87,600 and the expenditure of an equal amount.

The War Service Committee was directed to carry on a Fuel Conservation campaign and to assist government agencies that desired their cooperation.

The Society suffered the loss of three of its past presidents who had rendered distinguished service, Messrs. R. P. Bolton, J. F. Hale and J. I. Lyle, and appropriate memorials were adopted.

The November Council Meeting was held in Washington, D. C., and an announcement was made of the confirmation of the appointment of Prof. C. M. Humphreys, as Acting Director of the Research Laboratory.

The program for the 49th Annual Meeting was adopted and it was decided that while hostilities involving the United States continue, it would be the established policy of the Society that its meetings would be governed by the amount of pertinent technical information available for presentation, its value in war work and the time necessary to conduct the business affairs of the Society.

Amendments to the Constitution, By-Laws and Rules were approved by the Council and the rate for Initiation Fees and Dues for 1943 was adopted. Approval was also given to the expenditure of minimum round trip railroad and lower berth Pullman fare for Council Members and Chapter Delegates attending the Annual Meeting of the Society in Cincinnati.

Through the Chapter Relations Committee, speakers were supplied to Chapters requesting this service and the Committee was authorized to conduct a special study of the effect of war conditions on Chapter operations during the year.

The Council granted life membership to 16, reinstated 18 members, cancelled the membership of 253 and accepted 88 resignations. It was with regret that the loss of 23 members by death was recorded.

During the year, Transactions Volumes 46 and 47 were distributed. The Council carried out all duties required by the Constitution and By-Laws and believes that the present condition of the Society as reflected in the reports of the Officers and several committees will clearly establish that the present condition of the Society is sound.

Respectfully submitted,

THE COUNCIL

Secretary's Report

In handling the administrative work of the Society many unexpected and unusual problems were encountered during the past year. Employment of members was maintained at peak figures most of the year, but in some classifications there are signs of decreasing need of available manpower.

The rapid changes in location of many members engaged in war work greatly increased the work of maintaining accurate address files. Often the delay in receipt of notification of members' change of location held up delivery of Society mail and publications which is costly to the Society.

Early payment of dues was made by the majority of the membership and at the end of the year 91 per cent on the rolls were paid up and 9 per cent were in arrears, according to the report of the Certified Public Accountant. An additional 2 per cent has been collected since January 1.

Over 10,000 copies of The Guide were printed and distributed, and because of the heavy demand from govern-

ment agencies and others, the supply was exhausted by November. It was necessary to refuse a considerable number of orders for this edition, but this will probably be reflected in increased sales of the 1943 edition which will be ready about March 1.

Export licenses required by the Board of Economic Warfare were obtained for The Guide and Transactions after passing censorship.

An unexpected development last spring was the crisis in fuel oil distribution due to Army and Navy demands, destruction of tankers by submarines on the east coasts and inadequate facilities for overland delivery by pipe line and tank car. Despite the fact that the railroads made an unparalleled record in bringing oil to the eastern area the volume was not sufficient to meet all requirements. When the decision was announced that fuel oil and kerosene would be rationed, the Society's War Service Committee inaugurated an educational campaign on fuel conservation and received the support of numerous state governors in creating "War on Fuel Waste" week. The initial effort spread rapidly over 17 states originally selected for fuel oil rationing and later received greater impetus when 30 states were listed in the rationing program. On February 1 fuel oil rationing is to be effective in the Pacific Northwest states.

A great public demand for accurate information on fuel saving methods developed and the War Service Committee responded with the publication of a pamphlet listing Ten Ways to Save Fuel. This has been widely copied and distributed throughout the United States. The Society had representatives at a series of conferences in Washington, sponsored by the Fuel Rationing Division of OPA and strong criticism was offered to the Fuel Oil Rationing scheme as outlined and finally adopted. The Society representatives had no part in the development of the Fuel Rationing formula, which was a product of the OPA staff, and gave no approval to the plan.

It was possible, however, for Society members to assist the rationing boards on the application of the fuel rationing procedure and many compliments have been received for the work of volunteer groups notably in Illinois, Michigan and Missouri. Local Chapters have been helpful in their communities through the release of advice on fuel conservation measures through newspapers and by radio broadcast. All of this has required attendance at numerous conferences and much correspondence, as well as replies to many telephone inquiries for the services of competent engineers to survey and report on heating plants. This work of the Society has received widespread publicity and has increased its prestige as an organization devoted to public service.

Transactions Vol. 47 was compiled and distributed during the year to 2760 members and Vol. 48 is well under way.

In the headquarters office the editorial work on The Guide and 12 monthly issues of the Journal was carried on under the direction of the Guide Publication Committee and the Publication Committee of the Society. The maintenance of the membership files and the correspondence involved in the election of members and the reports of Committees was more extensive than usual.

It was necessary to carry on all of these activities with a reduced staff and a word of appreciation should be given to the headquarters personnel for their fine work.

A simplification of the procedure in handling speakers bureau activities reduced the time formerly required to carry on this work and also the effective cooperation of the Chairman of the Chapter Relations Committee was most helpful.

The Technical Secretary devoted much of his time to Research Committee work which was expanded in a number of cooperative institutions.

After a pleasant association of 7 years of service with the Society, John James will take up new duties in the field of research and development on February 1, and his associates extend their best wishes for his success in a new field of endeavor.

Special mention should be made of the splendid cooperation received from the members of the many committees, who have been serving throughout the year and who have contributed so much in making 1942 an unusually successful year for the Society.

Respectfully submitted,

A. V. HUTCHINSON, *Secretary.*

Finance Report

E. N. McDonnell, Chicago, chairman of the Finance Committee, then presented his report.

M. F. Blankin, Philadelphia, Pa.
President—1943

Accountants' Report

Tusa & LaBella
Certified Public Accountants
52 William St., New York

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS,
51 Madison Avenue,
New York, N. Y.

Gentlemen:

Pursuant to your request, we examined the books of account and records of the American Society of Heating and Ventilating Engineers—New York, N. Y., and the related Funds for the year ended December 31, 1942 and submit herewith our report.

The audit covered a verification of the assets and liabilities as of the close of business December 31, 1942 and a review of the operating accounts for the year then ended. For the period audited the recorded cash receipts were traced into the depositories; the cancelled bank checks were inspected, compared with the cash records and supported by payment vouchers; also the dues income and interest income from savings accounts and securities was accounted for.

A Balance Sheet reflecting the financial condition of the Society as of the close of business December 31, 1942 is submitted herewith and your attention is directed to the following comments thereon:

CASH

Cash on Deposit was verified by direct communication with the banks listed in the attached cash schedule and reconcilement of the balances reported to us with those reflected by the books of the Society.

The cash on hand for deposit and the petty cash were verified by count.

MARKETABLE SECURITIES

The securities, per the annexed schedule, were verified by direct communication with the Bankers Trust Company where same are deposited for safe-keeping. This asset has been included in the Balance Sheet at the cost of acquisition plus the accumulated and accrued interest earned thereon.

CERTIFICATE OF INDEBTEDNESS

The certificate of indebtedness issued to the Society by Farrar & Trefts, Inc., was verified by inspection of the instrument. During the current year a payment of $36.83 on account of the principal reduced the balance due to $153.20.

ACCOUNTS RECEIVABLE

A list of the membership dues receivable as of December 31, 1942 furnished to us by the management was checked to the individual ledger cards and found in agreement with the General Ledger Control. These unpaid dues were aged and may be summarized as follows:

Dues invoiced during 1942	$ 4,071.38
Dues invoiced during 1941	362.50
Dues invoiced during Prior Years	309.50
TOTAL	$ 4,743.38

Amounts due from Guide advertisers and other debtors were verified by trial balance of the individual ledger accounts and found in agreement with the General Ledger Control.

The reserves for dues and sundry accounts receivable found on the books of the Society are ample to cover losses that might result from uncollectible accounts.

INVENTORIES

The emblems on hand were counted by us and the inventories of paper and Transactions were verified by communication with printers.

These inventories were priced and computed by us. The following Transactions were reported to us.

Volume	Year	Quantity	Price	Amount
-0-	Prior Years	1350	$1.00	$1,350.00
43	1937	100	1.58	158.00
44	1938	117	1.58	184.86
45	1939	150	1.66	249.00
46	1940	134	1.25	167.50
47	1941	85	1.32	112.20
47	1941	150(unbound)	.96	144.00
			Total	$2,365.56

PREPAID TRAVELING

There were on hand railroad scrip books having a value of $24.46 which are to be turned in for refund.

PERMANENT ASSETS

Furniture, fixtures and library are shown herein at the book values without appraisal by us; we did, however, provide for depreciation of furniture and fixtures at the rate of (10%) ten per cent per annum.

ACCOUNTS PAYABLE

Amounts due creditors were determined by inspection of the unpaid bills found on file and examination of the record of cash disbursements made subsequently to December 31, 1942.

ACCRUED ACCOUNTS

Additional compensation to employees, covering the calendar year 1942, has been accrued by us in accordance with the formula contained in the council minutes of April 20, 1941. The computation is on the basis of six (6%) per cent of the Gross Guide Income of $44,846.65.

DEFERRED INCOME

All dues prepaid both by members and candidates for membership which were determined by trial balance of the dues ledger have been included in the attached Balance Sheet as a liability under deferred income.

RESERVE FOR TRANSACTIONS

The only Transactions remaining unpublished on December 31, 1942 was Volume 48. To cover cost of publishing this volume we have provided a reserve of $3,650.00 which is the same as the amount included in the 1942 budget.

FUNDS

An analysis of the following Funds reflecting the changes that have occurred in these accounts during the year ended December 31, 1942 is included herein:

General Fund
Reserve Fund
Endowment Fund
F. Paul Anderson Fund

There is included herein a complete financial report as prepared for the Committee on Research setting forth the financial position of the Research Laboratories as of the close of business December 31, 1942 and the results from operations of the year then ended.

Respectfully submitted,
Tusa & LaBella,
Certified Public Accountants.

January 16, 1943

S. H. Downs, Kalamazoo, Mich.
First Vice-President

BALANCE SHEET

American Society of Heating and Ventilating Engineers
New York, N. Y.
December 31, 1942

ASSETS

GENERAL FUND				
CASH				
On deposit	$37,989.46			
On hand for deposit	930.68			
On hand	100.00	$39,020.14		
In closed bank		380.89	$39,401.03	
INVESTMENTS (AT COST)				
Securities (Market Value $19,685.10)		18,074.06		
ADD: Accumulated interest	1,500.00			
ADD: Accrued interest	3.75	1,503.75	19,577.81	
CERTIFICATE OF INDEBTEDNESS				
Farrar & Trefts, Inc.			153.20	
ACCOUNTS RECEIVABLE				
Membership dues		4,743.38		
LESS: 40% for Research	1,608.84			
LESS: Reserve for doubtful	1,281.94	2,890.78		
		1,852.60		
Advertisers and Sundry debtors	22,580.66			
LESS: Reserve for doubtful	962.66	21,618.00		
Due from Reserve Fund		46.98	23,517.58	
INVENTORIES				
Transactions—Copies		2,365.56		
Transactions—Paper		745.25		
Emblems		90.98	3,201.79	
PREPAID TRAVELING				
Railroad scrip for refund			24.46	
PERMANENT				
Library		300.00		
Furniture and fixtures	2,688.84			
LESS: Reserve for depreciation	1,215.45	1,473.39	1,773.39	$87,649.26
RESERVE FUND				
Cash on deposit		4,990.02		
On hand for deposit		135.00	5,125.02	
Securities at cost (Market value $34,965.00)			34,965.00	40,090.02
ENDOWMENT FUND				
Cash on deposit			2,563.82	
Securities at cost (Market value $21,933.50)		24,413.65		
ADD: Accumulated interest	400.00			
Accrued interest	55.52	455.52	24,869.17	27,432.99
F. PAUL ANDERSON FUND				
Cash on deposit				1,085.83
				$156,258.10

LIABILITIES AND FUNDS

GENERAL FUND				
LIABILITIES				
ACCOUNTS PAYABLE			$16,484.83	
ACCRUED ACCOUNTS				
Additional compensation to employees			2,690.80	
DEFERRED INCOME				
Prepaid membership dues	$14,676.56			
LESS: 40% prepaid to research	5,442.40	$9,234.16		
Dues prepaid by candidates for membership		570.13	9,804.29	
RESERVE FOR PUBLICATIONS				
Transactions (1942) Volume 48			3,650.00	
			$32,629.92	
GENERAL FUND			55,019.34	$87,649.26
NOTE "A"—This Balance Sheet is subject to the comments contained in the letter attached to and forming a part of this report.				
RESERVE FUND				
Principal			40,043.04	
Interest earned due General Fund			46.98	40,090.02
ENDOWMENT FUND				
Principal			24,063.28	
Unexpended income			3,369.71	27,432.99
F. PAUL ANDERSON FUND				
Principal			1,000.00	
Unexpended income			85.83	1,085.83
				$156,258.10

BUDGET COMPARISON

American Society of Heating and Ventilating Engineers
New York, N. Y.

For the Year Ended December 31, 1942

	Actual	Budget Provision	Increases Decreases
INCOME			
Initiation fees	$ 1,755.00	$ 1,200.00	$ 555.00
Membership dues—Current	28,216.30	26,500.00	1,716.30
Membership dues—Prior	1,890.00	2,000.00	110.00
Editorial contract	15,999.96	16,000.00	.04
Profit—Emblems and frames	43.68	100.00	56.32
Profit—Reprints, books, etc.	162.44	300.00	137.56
Sales of Transactions	677.56	1,000.00	322.44
Interest—Savings banks and securities	532.86	500.00	32.86
Guide advertising	26,004.37	23,000.00	3,004.37
Sale of Guides	18,349.65	17,000.00	1,349.65
TOTALS	$93,631.82	$87,600.00	$ 6,031.82
EXPENSES			
A.S.A. membership	$ 100.00	$ 100.00	$ —0—
Meetings—Annual and Semi-Annual	1,268.85	1,400.00	131.15
Chapter allowance	970.82	1,000.00	29.18
Membership promotion	348.47	250.00	98.47
Speakers' Bureau	846.06	1,500.00	653.94
Subscriptions HPAC	5,854.34	6,000.00	145.66
President's Fund	1,375.29	2,000.00	624.71
Secretary's travel	1,096.73	1,000.00	96.73
Council and Chapter Delegates' travel	3,776.95	4,500.00	723.05
Salaries	18,016.50	18,500.00	483.50
Provision for additional compensation	2,690.80	3,200.00	509.20
Rent and light	3,603.92	3,600.00	3.92
Postage	1,977.14	2,000.00	22.86
General printing	968.78	750.00	218.78
Office supplies	523.93	400.00	123.93
Addressing and address changes	154.23	200.00	45.72
Telephone	698.42	500.00	198.42
Telegraph	322.29	250.00	72.29
Professional services	600.00	600.00	—0—
Bank charges	48.83	100.00	51.17
General Office expense	583.22	500.00	83.22
Membership certificates	173.94	150.00	23.94
Provision for depreciation of furniture and fixtures	268.88	200.00	68.88
Transactions—Volume 48	3,861.32	3,650.00	211.32
Initiation fees to Reserve Fund	1,755.00	1,000.00	755.00
Codes	121.74	750.00	628.26
War Service Committee	1,052.31	1,200.00	147.69
Special appropriation to research	5,000.00	5,000.00	—0—
Weather data report	173.47	165.00	8.47
	$58,232.28	$60,465.00	$ 2,232.72
GUIDE EXPENSES			
Paper	$ 3,850.00	$ 4,000.00	$ 150.00
Printing and binding	14,544.12	14,000.00	544.12
Express and mailing	2,767.47	3,500.00	732.53
Engraving and art work	316.20	450.00	133.80
Advertising sales promotion	1,120.31	1,500.00	379.69
Copy sales promotion	2,643.13	3,000.00	356.87
Editorial and advertising salaries	5,200.00	5,200.00	—0—
Committee expenses	268.97	350.00	81.03
	$30,710.20	$32,000.00	$ 1,289.80
YEARBOOK	$ 1,505.17	$ 1,500.00	$ 5.17
	$ 1,505.17	$ 1,500.00	$ 5.17
TOTALS	$90,447.65	$93,965.00	$ 3,547.35

BALANCE SHEET

American Society of Heating and Ventilating Engineers
Research Fund—New York, N. Y.
December 31, 1942

ASSETS

RESEARCH FUND		
CASH		
ON DEPOSIT		
Treasurer's Account—Bankers Trust Co.	$ 5,323.95	
Secretary's Account — Chase National Bank	2,834.09	
Director's Account — Forbes National Bank	701.41	
Thrift Account—Bank for Savings	3,301.20	$12,160.65
ON HAND FOR DEPOSIT		
Treasurer's Account—Bankers Trust Co.		4 183.90
ON HAND		
Petty cash—Pittsburgh, Pa.		14.84 $16,359.39
ACCOUNTS RECEIVABLE		
U. S. Navy Department		10,000.00
WORK IN PROGRESS		
U. S. Navy contract		1,889.74
PERMANENT		
Laboratory equipment		1.00
TOTAL RESEARCH FUND		$28,250.13
RESEARCH ENDOWMENT FUND		
CASH ON DEPOSIT		
Bank for Savings	$ 568.33	
Bank of U. S. in liquidation	152.53	720.86
		$28,970.99

LIABILITIES AND FUNDS

RESEARCH FUND		
DEFERRED INCOME		
PROJECTS		
Summer cooling	$1,859.45	
Glass study	1,088.38	$2,947.83
DUES—MEMBERS AND ASSOCIATES		
40% of 1943 dues prepaid in 1942	5,442.40	$ 8,390.23
ACCRUED ACCOUNTS		
Professional services		100.00
RESEARCH FUND		19,759.90
NOTE "A"—This Balance Sheet is subject to the comments contained in the letter attached to and forming a part of this report.		
NOTE "B"—The Research Funds as at December 31, 1942 had a contingent asset amounting to $1,608.84 arising from 40% of the Society s Members and Associates dues, payable upon collection by the latter.		
TOTAL RESEARCH LIABILITIES AND FUND		$28,250.13
RESEARCH ENDOWMENT FUND		
Principal	$ 600.00	
Unexpended income	120.86	720.86
		$28,970.99

BUDGET COMPARISON

American Society of Heating and Ventilating Engineers
Research Fund
New York, N. Y.
For the Year Ended December 31, 1942

	Actual	Budget Provision (Revised)	Increases Decreases
INCOME			
ASHVE—Dues	$17,986.40	$16,000.00	$ 1,986.40
ASHVE—Appropriation	5,000.00	5,000.00	—0—
Interest	49.04	45.00	4.04
CONTRIBUTIONS			
General	4,716.75	4,100.00	616.75
Earmarked—Corrosion	525.00	525.00	—0—
Earmarked—Convectors	600.00	600.00	—0—
Earmarked—Radiation and Comfort	150.00	150.00	—0—
Earmarked—Basement study	1,000.00	1,000.00	—0—
Earmarked—1941 Navy contract	1,645.06	1,645.00	.06
Earmarked—1942 Navy contract	10,000.00	16,000.00	6,000.00
TOTALS	$41,672.25	$45,065.00	$ 3,392.75
EXPENSES			
COOPERATIVE INSTITUTIONS.	$ 8,888.65	$11,700.00	$ 2,811.35
PITTSBURGH LABORATORY			
Radiation and comfort	513.17	735.00	221.83
Duct friction	181.78	180.00	1.78
Cooling load	232.72	235.00	2.28
Heating requirements	2,631.82	1,800.00	831.82
Basement study	810.65	1,350.00	539.35
Air conditioning industry	2,832.49	4,000.00	1,167.51
1941 Navy contract	2,436.10	2,400.00	36.10
1942 Navy contract	10,000.00	16,000.00	6,000.00
TOTALS	$28,527.38	$38,400.00	$ 9,872.62
OTHER			
1942 Navy contract administrative	4,512.00	4,000.00	512.00
UNEXPENDED INCOME OVER EXPENSES	8,632.87	2,665.00	5,967.87
TOTALS	$41,672.25	$45,065.00	$ 3,392.75

C.-E. A. Winslow, New Haven, Conn.
Second Vice-President

The appointment of the Resolutions Committee was then announced by Mr. Blankin, consisting of E. N. McDonnell, Chairman, B. M. Woods, Berkeley, Calif., and W. A. Russell, Kansas City, Mo.

The first paper presented, Warship Ventilating, Heating and Air Conditioning, by T. H. Urdahl and W. C. Whittlesey (complete paper published in February, 1943, ASHVE Journal Section, Heating, Piping & Air Conditioning) was given by both Commander Urdahl and Mr. Whittlesey. Perry West, Lexington, Ky., complimented the authors and expressed the opinion that the Navy was in good hands, judging from the presentation.

J. W. Markert, Washington, D. C., gave a detailed description of the heating and ventilating of ships for the half century 1893-1943. He described the new methods and the more extensive application and methods of heating, and the transition from natural ventilation through skylights and coils and heating with stoves and pipe coils to mechanical systems. He described the systems of some of the familiar transatlantic liners and showed how the basic work of Admiral A. W. Taylor was reflected in Naval vessel designs. He referred to the advent of modern air conditioning in passenger vessels and also described the first dehumidifying system for elimination of condensation in cargo spaces. He described the infinite number of steps which lead from a crude rule of thumb system of design to the present day scientific approach, and predicted that many changes in the art of ventilation, heating and air conditioning of ships will result in future years.

Chairman Blankin then presented Second Vice-Pres. S. H. Downs, Kalamazoo, Mich., who took the chair. Mr. Downs introduced the next author, W. B. Van Arsdel, who presented his paper, Some Engineering Problems of the New Vegetable Dehydration Industry (complete paper published in this issue, see page 157).

H. E. Lewis, Toledo, Ohio, asked if any effort had been made to record the different drying times, also pick up or elimination of moisture on the basis of vapor pressure.

C. Tasker, Toronto, Ont., inquired about the use of chemical dehumidification for the finishing off process.

L. T. Avery, Cleveland, Ohio, asked about probable moisture regain after drying.

J. D. Slemmons, Columbus, Ohio, questioned the possibility of drying of farm products on the farm.

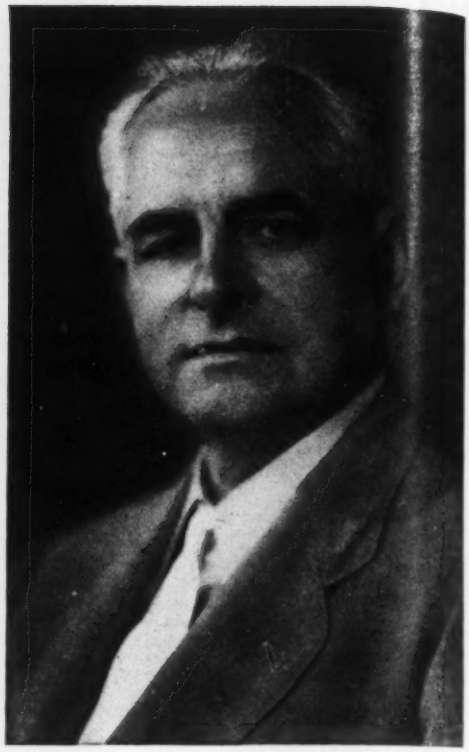
In reply to the questions, Mr. Van Arsdel explained that several methods of correlating figures between different drying runs had been made, but the conclusion was that wet- and dry-bulb temperature basis was favored as the most direct. He also stated that silica gel, activated alumina, and lithium chloride had been used in the finishing operation to remove the last 2 per cent moisture. He stated that dried material is packed in hermetically sealed cans as quickly as possible after drying so that there is no possibility of regain until the can is opened for use.

Mr. Van Arsdel further stated that home drying or farm drying products were on a relatively small scale, and that reasonably good products could be obtained, but might not pass present government purchase specifications, particularly on storage characteristics, but would prevent the waste of many farm products.

Chairman Blankin then adjourned the morning's session, announcing that the remainder of the program scheduled for the morning would be the first order of business at the afternoon session.

Second Session — Monday, January 25, 2:45 P. M.

The afternoon session convened in the ballroom of the Hotel Gibson, with First Vice-President Blankin presiding. Mr. Blankin turned the meeting over to Second Vice-President Downs, who called for the paper, Performance of Side Outlets on Horizontal Ducts, by D. W. Nelson and G. E. Smedberg (complete paper published in November, 1942, Journal Section, Heating, Piping & Air Conditioning), which was presented by Professor Nelson. Professor Nelson stated that this paper was the result of research sponsored by the Society at the University of Wisconsin, and brought out the fact that it is one of the divisions of research work conducted under the auspices of the Technical Advisory Committee on Air Distribution and Air Friction.



E. K. Campbell, Kansas City, Mo.
Treasurer

Mr. Blankin resumed the chair and introduced Alfred J. Offner, Chairman of the Guide Publication Committee, who presented the Report of the Committee.

Report of Guide Publication Committee

The 21st edition of the Heating, Ventilating, Air Conditioning Guide 1943 has been prepared under the stress of war time conditions. While recognizing the changes which have been made from standard practices, due to these war time conditions, the Guide Publication Committee nevertheless has retained in the various chapters the high standards and basic information that has characterized former editions. Departures from these standard practices and changes in engineering methods and design, brought about by war conditions, are outlined in a new supplement in this edition entitled, Emergency War Practices.

In accordance with the policies adopted for the issuance of a new Guide, approximately two-thirds of the forty-seven chapters have been reviewed and of these twenty were completely rewritten with minor revisions to eight others.

Chapter 48 has been added, entitled Abbreviations, Symbols, Standards, and includes a new compilation of state laws and codes covering design and installation requirements relating to the heating, ventilating or air conditioning of buildings.

The chapter on Thermodynamics of Air and Water Mixtures has been expanded to include some new information on pressure and temperature relations at various altitudes above or below sea level, as well as some additional examples dealing with the cooling and heating load. The material covered in the chapter on Heat Transmission Coefficients and Tables has been enlarged to include some new data on basement floor and basement wall coefficients, which were developed by recent ASHVE Research Laboratory investigations.

The Heating Load chapter has been completely rewritten and a new design temperature zone map has been added. Tabular data giving heat gain from various sources are a new feature of the chapter on Cooling Load, and in addition the illustrative example at the end of the chapter has been expanded. Chapter 11 has been given a new title Estimating Fuel Consumption, and the material in this chapter has

been simplified in order to clarify the subject of degree-days in calculating fuel estimates.

The chapter on Radiators and Convectors was completely rewritten and condensed so that recent experimental data could be added. Similarly, the material dealing with Hot Water Heating Systems and Piping is new, with charts, tables and a group of graded examples added to assist the engineer in designing a system of this type. Minor revisions were made to the chapter on Mechanical Warm Air Furnace Systems, with the inclusion of standards which were recently adopted by the industry.

Chapters 22 and 23, dealing with unit types of heaters, ventilators, humidifiers, air conditioners, and air coolers, and also attic fans, have received major revisions with emphasis on new developments in the design of such equipment. New data will be found in the chapter on Air Cleaning Devices covering problems encountered where lint is an important factor. All of the material in the chapters dealing with Air Distribution, Air Duct Design and Sound Control has been reviewed, rewritten and correlated to take into consideration the results of recent Society sponsored research investigations. Other chapters which have been completely revised are Motors and Motor Controls, Industrial Air Conditioning, Industrial Exhaust Systems, and Radiant Heating. Some information on the design of solar water heaters has been added to the chapter dealing with Water Supply Piping and Water Heating. In addition to the chapters specifically mentioned all others were reviewed and checked.

An important part of The Guide is the Catalog Data Section. Much useful design data and information have been supplied by the various manufacturers. Equipment has been grouped in subdivisions for convenience in locating data in reference to a particular type of apparatus.

The Committee is sorry that the new Guide could not be ready for inspection at this meeting. Due to the pressure of other work on the part of some contributors, receipt of a number of the manuscripts was delayed, also printing difficulties were encountered. We expect that the new Guide will be delivered late in February.

Your Chairman wishes to take this opportunity to express his sincerest thanks to the members of the Committee, to John James, Technical Secretary, for his fine assistance and cooperation, to those men who have so unselfishly contributed of their time and knowledge, to A. V. Hutchinson, Secretary of the Society, for his guidance and help, to Charles N. Winter for his work on the Catalog Data Section, and to the New York office staff. Any success the 1943 Guide may have is entirely due to these people.

Respectfully submitted,

ALFRED J. OFFNER, *Chairman*,
GUIDE PUBLICATION COMMITTEE.

Report of Tellers

C. S. Koehler then presented the Report of the Tellers of Election as follows:

Ballot for Officers

President—M. F. Blankin	808
First Vice-President—S. H. Downs	809
Second Vice-President—C.-E. A. Winslow	806
Treasurer—E. K. Campbell	812
Members of Council (three-year term)	
J. F. Collins, Jr.	813
James Holt	810
E. N. McDonnell	814
T. H. Urdahl	812

Scattering votes for: *President*—S. H. Downs, W. L. Fleisher, A. P. Kratz, A. J. Offner, J. H. Walker, and C.-E. A. Winslow; *First Vice-President*—L. W. McCrea, E. N. McDonnell, and C.-E. A. Winslow; *Second Vice-President*—A. P. Kratz and F. C. McIntosh; *Members of Council*—L. T. Avery, G. C. Davis, R. E. Backstrom, C. W. Helstrom, Axel Marin, and J. H. VanAlsburg.

Ballots for Committee on Research

Three-year term	
H. J. Rose	812
L. P. Saunders	811
L. E. Seeley	813
A. E. Stacey, Jr.	814
C. Tasker	814

Scattering votes for: Albert Buenger, R. S. Dill, M. C. Giannini, B. F. McLouth, J. H. Van Alsburg and M. S. Wunderlich.

Total ballots received—833; legal ballots—814; invalid—19.

Board of Tellers,

CHARLES A. FULLER, *Chairman*.
R. W. CUMMING.
C. S. KOEHLER.

Mr. Blankin then called for the paper, Army Fuel Consumption Studies of 1941-42, by L. C. McCabe, S. Konzo and R. E. Biller (complete paper published in January 1943 Journal Section, Heating, Piping & Air Conditioning), which was given by Mr. Biller, who is associate engineer with the U. S. Army, Office of Chief of Engineers, Construction Division.

G. H. TUTTLE, Detroit, Mich. (written): An analysis of the information presented in this paper would seem to indicate that a better and more complete method of heat regulation would be very desirable in all army camp buildings.

Theoretically, the heat consumption of any building, regardless of occupants, location, or type of construction, is proportional to the indoor-outdoor temperature difference. This being the case, the heat consumption of buildings for any period should be proportional to degree-days so long as the same indoor temperature is maintained for all outdoor temperatures. Fig. 5, which presents pounds of coal per week compared with weekly degree-days for barracks in four camps, indicates that in one case, at least, this relationship is true. In the case of Fort Bragg, the pounds of coal consumed per degree-day is approximately 16.5 for all weather conditions from the warmest to the coldest. This indicates that the operation is consistent. However, in Fig. 8, where the total fuel allowance is presented, Fort Bragg is above the average of other camps so it must be consistently high. In terms of operation, this would seem to indicate that perhaps fairly constant indoor temperatures were maintained but that either the indoor temperatures were maintained higher than necessary or for longer hours.

If it is possible to maintain a constant heat consumption per degree day for all outdoor temperatures in one camp, it seems probable that the same could be done for other camps, regardless of geographical location and average outdoor temperatures.

Further evidence to the fact that apparently indoor temperatures are maintained higher than necessary, or at least the average heat loss is higher than necessary, is indicated from Tables 3 and 4 where "Fuel Allowance" figures are presented. In Table 3, the average fuel allowance per degree-day, excluding group No. 7, is 3.7 lb per 1000 sq ft of floor area. If this ratio is applied to a five-room house with 1000 sq ft of floor area in a geographical location where the annual degree-days are 6500, the expected coal consumption for a normal year would be in excess of 12 tons per year. General practice would indicate that a home owner would have to be very extravagant to consume this amount of coal.

The total fuel allowance in tons per year for hospital-type buildings is presented in Table 4. For 6500 degree-days, the total fuel allowance would be 35.5 tons of coal per 1000 sq ft. By comparison to this figure, a hospital served with district steam, where accurate metered steam consumption data are available, used 81,000 lb of steam annually per 1000 sq ft. In terms of coal burned at 60 per cent efficiency, this consumption would be 5.4 tons per year, or approximately one-sixth of the fuel allowance value given in Table 4.

The civilian population of the United States, particularly those living in the east and midwest, are quite conscious at the present time of fuel oil rationing. With all the information available in this report, the opportunity of applying the OPA fuel oil formula is more than the average civilian can resist. Assuming the conditions in the previous example, and applying it to No. 1 oil with 138,000 Btu per gallon, the OPA formula would reduce the oil consumption from 2200 gal per square feet per year to 1161, or a reduction of 47 per cent.

The authors are certainly to be commended on their method of presenting the voluminous amount of data that was collected for the report. It is just one more example of the fact that war is a big business and that the supply problem, perhaps, is not as spectacular as other phases of the war effort, but is just as important.

W. A. Danielson, Memphis, Tenn., thought that it might be of historical interest to know that studies of Army fuel allowances were started about 1915, and many tests were made at the Bureau of Mines to determine the amount of fuel burned per square foot of radiation. In the absence of the degree-day method the United States was divided into 9 zones of about equal average temperatures, and allowances were figured for every conceivable type of building that was to be found in those areas. It was not until about five or six years ago that the degree-day basis was adopted.

N. D. Adams, Rochester, Minn., thought a point that the authors apparently had missed was the fact that a difference in humidity has a definite effect in all types of buildings, because, as the degree-days increase, frosting up of the porous materials reduces the heat loss, with the result that a reduced amount of heating is required as the degree-days increase.

L. E. Seeley, New Haven, Conn., referred to a publication by the U. S. Housing Authority which has made a study of heat losses which roughly expressed in terms of Btu per room per degree-day, indicated that substantial savings could be obtained in the South where the degree-days were low as compared with structures in the North.

W. A. Danielson further stated that frosting up often occurred in barracks because medical authorities required opening of windows for ventilation.

R. L. Davison, New York, N. Y., referred to a study in a group of apartment houses which indicated that fuel oil consumption over the past three years was more closely correlated with 70 degree-day base temperature rather than 65. It was also found that heating could be controlled more readily in the apartments having Southern exposure and located close to the boilers, by opening windows which was a common practice in apartments, but was not true of individual homes where the owner pays for his own heat.

F. E. Giesecke, Urbana, Ill., thought that the difference in heat requirements mentioned by Professor Seeley for Southern and Northern locations is due to the fact that there are many days in the South when heat is needed, but when under the 65 degree basis there are no degree-days so that heat requirements should be calculated on a degree-hour basis rather than by the degree-day method.

L. G. Miller, East Lansing, Mich., said that a local oil company had found that deliveries on a degree-day basis, using 70 rather than 65, had given more satisfactory results.

V. H. Wilson, Nashville, Tenn., stated that in housing projects in some of the Southern states space heating was eliminated, but because higher fluctuations in temperature have short periods, it would be desirable to make designs on a degree-hour basis rather than the degree-day.

James Holt, Cambridge, Mass., asked whether the insulation used was of the same thickness and type throughout the barracks.

Mr. Biller gave a detailed reply to all of the questions and stated that the studies made in barracks buildings were known as the 700 type construction, but said that the fuel studies have been carried on in more than 25 types of buildings, and that emphasis had been put on the barracks because they represented at least 50 per cent of the buildings of the usual Army post. He reviewed the studies that lead to the selection of 65 degree basis and indicated that data received on degree-hours did not indicate that there was enough difference to warrant change of method.

The next paper entitled, Performance Characteristics of a Coal-Fired Space Heater (complete paper published in January 1943 Journal Section, Heating, Piping & Air Conditioning) was given by the author, R. C. Cross, Chicago, Ill.

H. R. Limbacher, Columbus, Ohio: Considered that many types of heating stoves had been perfected since the days of Franklin, but few had been tested except on the basis of firing at full draft. He indicated the test procedure was similar to a tentative standard proposed by the National Bureau of Standards with the exception of the draft limit used. He asked that information about the method used in firing bituminous coal be given and indicated that the record on smoke emission had little significance with respect to smoke ordinance requirements in many cities.

Mr. Cross described some of the installation practices that were common, and indicated the necessity for the draft rate used; also indicated that the effect of a higher draft and the introduction of additional air would have reduced the CO_2, accelerated the combustion rate and increased the output, but would have been offset by the increased flue gas temperature resulting from the higher rate of burning.

Second Vice-President Downs then took the chair and introduced W. S. Harris, co-author with Professors A. P. Kratz and M. K. Fahnestock, who presented the paper, Operation of the Research Home with Reduced Room Temperatures at Night (complete paper published in December 1942 Journal Section, Heating, Piping & Air Conditioning).

Mr. Davison, who is director of housing research for John B. Pierce Foundation, New York, was then called upon to describe briefly the research conducted in a group of apartment buildings in New York, known as the Hillside Apartments, a group of 1415 apartments. There are five different buildings, with different heating plants for each, and the approach was quite different from the approach in the Urbana study. An attempt was made to determine what temperature would be obtained with a reduction in fuel oil consumption to conform to the fuel rationing program. Throughout the test period of 28 days the heat was on 8 hours a day, compared with 16 hours a day last year. Operating the heating plant that way there was a saving of 42 per cent of the fuel. Analyzing the temperatures and oil consumption, it was estimated that in January and February, utilizing a third less fuel than was utilized in previous years, the average temperature in the daytime would be about 60 F.

In practically all cases people in apartments at some distance from the boiler used auxiliary heat. For the duration of the test a field staff of seven people made temperature readings and obtained statements from tenants, which indicated that 70 per cent of the people questioned stated they were not warm enough and 30 per cent objected quite strenuously to the temperatures that prevailed.

Report of Constitution and By-Laws Committee

Albert Buenger, Chairman of the Committee on Constitution and By-Laws, gave the Committee's report. He stated that all Amendments to the Constitution and By-Laws and Regulations Governing the Committee on Research had been sent out in printed form to Society members December 21, 1942:

(New) Art. C-XIII—Research—*Section* 2. The members of the Committee on Research will be held harmless by the Society from any liability to third persons, resulting from any acts in their capacity as Committee Members or when engaged in the affairs or business of the Society. Any such liability caused by the willful misconduct of any Committee Member will not be assumed by the Society.

(New) Art. B-IV—Admission Fees and Dues—*Section* 11. The Council may establish rules applying to remission of dues to members in the uniformed service of the Government during such times when the United States is at war.

Art. B-XI—Funds—*Section* 6. After December thirty-first and before the Annual Meeting of the Society in January, the accounts of the Society shall be audited by a certified public accountant, selected by the Council. The auditor's report shall be presented at the Annual Meeting of the Society by the Chairman of the Finance Committee, and published in the Society JOURNAL.

To be amended to read—*Section* 6. After October thirty-first and before the Annual Meeting of the Society in January, the accounts of the Society shall be audited by a certified public accountant, selected by the Council. The auditor's report shall be presented at the Annual Meeting of the Society by the Chairman of the Finance Committee, and published in the Society JOURNAL.

Art. VI—Patents—*Section* 1. If any discoveries are made under Co-operative Research agreements *with universities or colleges** which are deemed worthy of patent application by the Committee on Research, any such applications and patents shall be owned jointly by the American Society of Heating and Ventilating Engineers and the University, with a share to be determined by the Committee on Research and the University, to be owned by the person who makes the discovery. The cost of securing the patents shall be borne by these parties as their several interests appear.

(New)—*Section* 2. If any patentable invention or discovery is made by reason of investigations under Co-operative Research agreement with the Department of Interior and the Society, the Department and the Society shall have the right to use the patent without payment of royalty or compensation.

At the time of application for such patent, it shall be dedicated to the people of the United States or assigned to the United States as represented by the Secretary of the Interior.

Mr. Buenger read Art. C-XIII *Section* 2 and said that it would be submitted to the Society for vote by letter ballot if approval was given by the majority of those present.

* Section 1 amended by addition of words in italics.

On motion of Mr. Buenger, seconded by Mr. Campbell, it was

VOTED: THAT Art. C-XIII *Section* 2 as presented be approved.

Mr. Buenger read Art. B-IV *Section* 11 and offered a motion for approval which was seconded by N. D. Adams. In the discussion, Mr. McDonald of Winnipeg questioned whether the amendment covered Canadian members. Mr. Tasker proposed that the amendment be reworded and offered the following substitute which was seconded by Mr. McDonald:

Art. B-IV *Section* 11. The Council may establish rules applying to remission of dues to members in the uniformed service of the Government during such times as his Government is at war.

On vote the amendment to Art. B-IV *Section* 11 was adopted.

Mr. Buenger then proposed the adoption of Art. B-XI *Section* 6 which was seconded by Mr. Avery.

On vote the amendment to Art. B-XI *Section* 6 was adopted.

Mr. Buenger explained that the amendment to the Regulations Governing the Committee on Research had been requested by the Department of Interior and he proposed the adoption of Art. VI *Section* 2, which was seconded by Mr. Triggs.

On vote the amendment to Art. VI *Section* 2 was adopted.

Chairman Blankin said that two amendments to the By-Laws had been prepared by the Committee on Constitution and By-Laws in accordance with the resolution adopted at the 48th Annual Meeting of the Society in Philadelphia, January 26, 1942 and these amendments to Art. B-VIII *Section* 11 and a new *Section* 12 had been sent to members 30 days in advance of the meeting, in accordance with the requirements of the By-Laws. He called on Mr. Buenger to present the proposed amendments.

Mr. Buenger presented the following statement:

Those of us who attended the convention at Philadelphia last year witnessed one of the best indications of the virility, strength and democracy of this Society. At that meeting a very lively discussion was carried on covering the constitutional amendments concerning the method of nominating Society Officers and Council Members.

The matter was finally referred to the Constitution and By-Laws Committee for further study and recommendation; the instructions of the Convention requiring consultation with the membership.

Since that meeting your Committee has studied the present By-Laws and the Minutes of the Philadelphia Meeting. It has exchanged considerable correspondence. Several conferences between members of the Committee and Secy. Hutchinson were held.

From these negotiations came the "Report to A.S.H.V.E. Members" from the Committee under date of October 31, 1942.

Here again a lively interest was evident judging from the number and quality of replies received. A majority of these was in favor of Plan "A" which is essentially the plan submitted today.

A final meeting of the full committee with Secy. Hutchinson and Mr. Matthews, the legal advisor to the Society, was held in New York on December 4, 1942. At this meeting the final draft was made and submitted to the membership under date of December 21, 1942.

This draft includes many of the suggestions received.

Briefly, the proposed method of nominating the officers includes the following innovations:

1. The establishment of a chapter delegates committee as part of the constitutional structure of the Society whose duties include the task of selecting a nominating committee.
2. The Chairman of the Nominating Committee shall be the past president retiring from the Council. The other members may be any four members of the Society except officers or council members, or members of the chapter delegates committee.
3. Candidates for President, Vice President or Treasurer shall have served at least two years on the Council.
4. At least six members are to be selected as candidates to fill the four vacancies on the Council.

The Committee has unanimously agreed on these amendments and feels that they represent not only a just and fair solution of the problem but also a good cross-section of the views of the entire membership.

Finally, your chairman wishes to take this opportunity to thank the Society as a whole for their valuable replies and suggestions, and the Committee Members for their excellent cooperation, sound advice, constructive criticism and able assistance in the preparation of these amendments.

Mr. Buenger moved that the Amendments to Art. B-VIII *Section* 11 and *Section* 12 be approved. The motion was seconded.

Chairman Blankin called attention to the lateness of the hour and said that there was no desire to curtail debate but requested those who spoke on the amendment to be brief as a number desired to be heard.

After the remarks of C. H. Randolph, Milwaukee, who opposed the adoption of the amendment, a motion was offered by M. F. Carlock, St. Louis, seconded by F. E. Triggs, Des Moines, that the meeting adjourn at 6:00 p. m and that the discussion on the amendments be continued at 9:00 a. m. Tuesday, January 26.

On vote the motion was adopted.

Third Session — Tuesday, January 26, 9:15 A. M.

The session was called to order by First Vice President M. F. Blankin who requested C. H. Randolph to continue his comments on the Amendments to Art. B-VIII of the By-Laws.

T. D. Stafford, Grand Rapids, thought that the Committee proposed was too small and that a matter as important as this should not be passed by a small majority and felt the question should have wide support as it involved the welfare and unity of the Society.

C. F. Boester, Lafayette, Ind., said that the matter of change in the method of choosing Officers and Council members had been fully discussed by the Chapter Delegates group and said that the canvas taken indicated that a considerable number of the Society members had expressed their opinions through instructions to Chapter Delegates.

J. F. Collins, Pittsburgh, Chairman of the Chapter Delegates Committee when requested for information on the Chapter Delegates' vote stated that 11 opposed the Amendments, one favored them and 14 did not vote.

E. K. Campbell, Kansas City, expressed the opinion that there was no real desire for a change in the method of selecting Officers and Council Members and he believed that it would be a mistake to take the nominations away from the Chapters.

E. M. Mittendorff, Chicago, thought that if a change is necessary the Committee appointed should be given some idea of what was wanted.

At the suggestion of E. Elliot, Philadelphia, Mr. Buenger was requested to repeat the statement he gave previously and offer any other comments that he desired. Mr. Buenger stated that the matter had been taken up with the Chapter Delegates Committee last January in Philadelphia and again informally in June at St. Paul with the Nominating Committee, but no suggestions were received from either of these groups. He indicated that the Committee on Constitution and By-Laws had discussed the possibilities of a Nominating Committee of seven but had received no comments objecting to a Committee of five. He said that a majority of the comments favored Plan "A" which had been outlined by the Committee, but many had favored Plan "C" which provided for a Nominating Committee entirely of past presidents. It was the Committee's idea that the Chapter Delegates could select four members of the Committee and the plan in no way removed the power from the Chapter Delegates to select the officers. It was believed that a contest for Council Members would stimulate voting as past custom indicates that less than 25 per cent of the members vote. In closing Mr. Buenger pointed out that the Committee had no system to advocate. It had been requested to turn out an amendment to the By-Laws, after consultation with the membership and study the minutes of the Chapter Delegates Meeting and the discussion at previous Society meetings on the subject. The Committee felt in presenting these amendments to Art. B-VIII, that they were expressing the wishes of the Society.

Mr. Avery requested Chairman Blankin to read the directions given to the Committee by the Society under the resolution adopted by the Society in January 1942 and this was done.

C. S. Koehler, New York, expressed the feeling that the Committee had carried out its assignment but felt that the subject should go to the membership for longer study so as not to tie up a meeting. He also stated that he had definitely indicated opposition to a five-man committee in advance of the meeting.

Chairman Blankin then put the question for adoption or rejection of the Amendments to Art. B-VIII *Sections* 11 and 12.

On vote, counting of hands showed 20 in favor and 40 opposed. The Chairman declared the motion lost.

Chairman Blankin indicated that one amendment to the regulations governing the Committee on Research had not been voted on and Mr. Buenger presented Art. VI *Section* 1 relating to patents. The addition of four words was made in connection with cooperative agreements and

On motion of Mr. Buenger, seconded by Mr. Elliot, it was, VOTED to adopt the amendment.

Chairman Blankin said he wished to express the thanks of the Officers, the council and all of the members for the fine work done by the Committee on Constitution and By-Laws and the amount of time and thought they had devoted to it and the careful consideration that they had given to all phases of the subject.

The first technical paper, The Effect of Convection in Ceiling Insulation, by G. B. Wilkes and L. R. Vianey (complete paper published in February 1943 Journal Section, Heating, Piping & Air Conditioning) was given by Mr. Vianey, instructor in mechanical engineering at the Massachusetts Institute of Technology.

H. E. Lewis, Toledo, Ohio (Written): The results of these tests are very interesting in that they point out the need for comprehensive and continuous research even on materials such as mineral wools, that is, rock, slag and glass fibers which are well recognized for their performance in the home insulation field.

It is believed timely to mention that the National Mineral Wool Association undertook rather exhaustive thermal insulation studies sometime ago, under the direction of Prof. F. B. Rowley at the University of Minnesota. This research program includes studies of the following phases of insulation, with particular reference to k factors and/or over-all heat transmission coefficients:

1. The effect of installed densities for a given material.
2. The effect of different forms of the same material, that is, bats, blankets, loose wool or pneumatically applied blowing wool.
3. The effect of different insulation thicknesses as installed.
4. The effect of convection currents in ventilated attics, with and without insulation and/or flooring.
5. The effect of position, *i. e.*, whether insulation is installed horizontally or vertically.
6. The effect of different mean temperatures.
7. Comparative results obtained with different types of test equipment, such as guarded hot box *versus* a heat meter, or hot plate.

This research program would have been completed in time for this meeting except for delays due to priority on certain instruments. Not having a copy of the complete program at hand, I cannot state that these objectives as listed are in their entirety; however, they do cover many points for which the National Mineral Wool Association has been convinced of the need of more actual test data, to confirm the existing values specified in the ASHVE Guide. My experience from a practical standpoint is that the values in the Guide are substantially correct.

Having participated in this program as a member of the Technical Committee of the National Mineral Wool Association, I believe it should be mentioned that the results of the tests described in this paper differ considerably from Professor Rowley's findings up to the present time. This statement is based on a recent progress report from Professor Rowley which said in effect, that actual k factors tested to date for mineral wools, are in agreement with values currently given in The Guide.

It is to be expected that there will be *some* range of coefficients reported in such parallel research activities. Such differences may be due to the testing equipment, selection of specimens, test procedures, or to the method of installation used. To avoid extreme variations as in this case it would seem essential to first establish standard equipment and test procedures for guarded hot box tests. Then, with regard to installation methods, the manufacturers' specifications should be followed. For example, blowing wool—as one type of granulated wool is commonly called—should be applied in the test panel by means of recommended pneumatic equipment, not by hand packing.

These comments are made in a spirit of cooperation, not in an effort to advocate one set of data in favor of another. As engineers charged with a responsibility, we want to have the complete facts—letting the chips fall where they may.

It is to be expected that the comprehensive tests now being conducted as previously described, will contain definite and helpful information on the points covered in this paper. They should be awaited before any decision or acceptance is made.

T. T. Tucker, Atlanta, Ga., questioned the author as to whether different types of mechanical or blow-in insulation were tried, and if they used different methods of handling the different materials.

A. P. Kratz, Urbana, Ill., asked the author for his opinion as to what happens in the case of the wool blown into a vertical wall.

G. L. Tuve, Cleveland, Ohio, emphasized the point that the situation with regard to handling Society standards needs a thorough investigation promptly because we are not getting anywhere.

The idea presented in the paper gives an over-all coefficient for a wall and it is a very complicated test by which that over-all coefficient is determined. It seems to me, offhand, that anyone reporting over-all coefficients should be required to report the surface coefficient that accompanies the over-all coefficients in all possible cases. He was critical of the lack of detail about the use of fans inside the test box, because there are a thousand different ways that fans can be put inside a test box, and they will give all kinds of different results.

He advocated better methods of standardization so that test results would be comparable.

Mr. Vianey replied to Mr. Tucker's question by stating that they tried to put the rock wool in to correspond with commercial practice. He pointed out that no blowing equipment was available, but the same densities secured with the blow-in machine were approximated as closely as possible.

In replying to Professor Kratz, the author explained that it has been shown that, in the regular box tests, the wool blown into a vertical wall does not live up to the plate test methods. He then gave some calculations and explained that they have never been able to get it lower than 0.10, so that convection must exist even in a vertical wall.

In summing up, the authors welcomed the criticisms, which they had expected. The box that they used was the standard box that was discussed in one of the Society's committee papers some time ago. The equipment was new and was tested for accuracy in several ways before the tests were run. Commenting on Professor Tuve's remarks, Mr. Vianey said that the surface coefficients were measured and said that one of the purposes of the paper was to stir up a good discussion in the hope that it would be the means of getting the real data in usable form for the engineer.

The next paper, Summer Comfort Factors as Influenced by the Thermal Properties of Building Materials, by C. O. Mackey and L. T. Wright, Jr. (complete paper published in December 1942 Journal Section, Heating, Piping & Air Conditioning) was presented by Professor Mackey, professor of heat power engineering at Cornell University.

Mr. Wright: In the complete mathematical solution it is evident that, for fixed values of h_o and h_i, the decrement factor, λ_n, and the lag angle, ϕ_n, are functions only of $k\sigma_n$ and $\sigma_n L$.

Assume a material with properties designated by the subscript 1 for which it is desired to find λ_{1n} and ϕ_{1n} for harmonics higher than the first. For this material

$$\sigma_{1n} L_1 = \sqrt{\frac{0.1309\ n\ (\rho c)_1 L_1^2}{k_1}} \quad \ldots\ldots (1)$$

and

$$k_1 \sigma_{1n} = \sqrt{0.1309\ n\ k_1\ (\rho c)_1} \quad \ldots\ldots (2)$$

For each higher harmonic we wish to find an equivalent material which has such thermal properties and thickness that its *fundamental* decrement factor and lag angle are equal respectively to the *higher order* decrement factor and lag angle of material 1. Designate the properties and thickness of this equivalent material by the subscript e. Now

$$\sigma_{e1} L_e = \sqrt{\frac{0.1309\ (\rho c)_e L_e^2}{k_e}} \quad \ldots\ldots (3)$$

and

$$k_e \sigma_{e1} = \sqrt{0.1309\ k_e\ (\rho c)_e} \quad \ldots\ldots (4)$$

By equating Equations (2) and (4) we obtain the following:

$$k_e\ (\rho c)_e = n\ k_1\ (\rho c)_1 \quad \ldots\ldots (5)$$

By equating Equations (1) and (3) we obtain the following:

$$\frac{(\rho c)_e\ L_e^2}{k_e} = n\ \frac{(\rho c)_1\ L_1^2}{k_1} \quad \ldots\ldots (6)$$

Divide Equation (6) by Equation (5) to obtain

$$\left(\frac{L_e}{k_e}\right)^2 = \left(\frac{L_1}{k_1}\right)^2 \quad \ldots\ldots (7)$$

Now examine Equations (5) and (7). Choose $k_e = k_1$; $L_e = L_1$; and $(\rho c)_e = n(\rho c)_1$. Then $\lambda_{e1} = \lambda_{1n}$ and $\phi_{e1} = \phi_{1n}$.

It should be pointed out that a much more satisfactory approximate equation than Equation (13) for finding the

inside surface temperature at any time of the day can be given. This equation is

$$t_o\left(\theta + \frac{\phi_o}{15}\right) = t_1 + \frac{\frac{1}{h_o}\left(t_{em} - t_1\right)}{\frac{1}{h_o} + \frac{L}{k} + \frac{1}{h_2}} + \lambda_o\left(t_{eg} - t_{em}\right)$$

Equation (13) of the paper was given only because it gave a simple method of plotting Charts D & E of Figs. 4 and 5. These charts are reasonably accurate, but not as accurate as the results calculated from the equation just given.

Victor Paschkis, New York, N. Y., (written): This paper contains very interesting charts for the calculation of the periodic flow of heat through single layer walls. The charts are, however, as I understand, based on some assumptions, one of which leads to so considerable an inaccuracy as to render doubtful the practical usefulness of the charts as presented in the paper:

The assumption that it is sufficient to work with the *fundamental* sine wave and that it is permissible to neglect all higher harmonics.

To bear out this statement, reference is made to Table 2 of the paper. The fourth column, entitled, Approximate Temperature of Inside Wall Surface (Equation 13), shows the temperatures as they could be read from the graphs, Figs. 4 and 5. These graphs are calculated on the basis of the above mentioned assumption (i.e., using the fundamental only). The fifth column, entitled, Exact Temperature of Inside Wall Surface; calculated from complete series solution (Fig. 2), is based on a calculation where this simplifying assumption is not made.

At first sight, the two columns appear to check very closely. However, the point of interest is of course not the inside wall surface temperature, but the heat flow from the inside surface to the (constant) inside air temperature. The inside film conductance is 1.5 Btu per square foot, hour, deg Fahrenheit. The heat flow is then 1.5 times the difference between the inside wall surface temperature and the constant inside air temperature. This air temperature is assumed to be 80 F.

The accuracy of the charts can thus be determined as follows: deduct from every value in columns 4 and 5 the constant inside air temperature of 80 F; compare the differences.

Thus the following figures and facts were found:

1) The approximate values lie consistently below the accurate values.
2) Only at one time (4 P.M.) is the error 20 per cent (Temperature difference 1.5 instead of 1.8). At all other times the error is much larger. E.g. at 12 noon it is 425 per cent (Temperature difference 0.4 instead of 1.7).
3) The total heat flow (over the 24-hr period) following the charts (column 4) is 6.9 Btu per square foot, while the correct value (column 5) is 38.5 Btu per square foot or 5.6 times as high.

In Table A the approximate and accurate values of heat flow are tabulated for the various hours of the day. The constant inside film conductance is 1.5 Btu per square foot, hour, deg Fahrenheit; the constant inside air temperature 80 F.

Table A

Time	Values of Heat Flow in Btu/sq ft. hr from inside wall surface to air. Film conductance 1.5 Btu/sq ft, hr, F; air temperature 80 F.	
	Approx. Value (Equ. 13)—Charts 4 & 5	Acc. Value (considering higher harmonics)
12 noon	+0.6	2.55
1 P.M.	+1.2	2.70
2 P.M.	+1.8	2.85
3 P.M.	+2.1	2.85
4 P.M.	+2.25	2.70
5 P.M.	+1.8	2.55
6 P.M.	+0.9	2.40
7 P.M.	+0.3	2.10
8 P.M.	+0	1.8
9 P.M.	—0.15	1.5
10 P.M.	—0.15	1.35
11 P.M.	—0.30	1.05
12 P.M.	—0.45	0.90
1 A.M.	—0.60	0.60
2 A.M.	—0.60	0.60
3 A.M.	—0.60	0.45
4 A.M.	—0.60	0.45
5 A.M.	—0.60	0.45
6 A.M.	—0.45	0.60
7 A.M.	—0.30	0.90
8 A.M.	—0.15	1.2
9 A.M.	+0.15	1.65
10 A.M.	+0.30	1.95
11 A.M.	+0.45	2.4
Average	+0.287	1.606

It is obvious that the approximate solution yields answers which are not accurate enough for practical purposes.

The authors, incidentally, do not tell how many higher harmonics they have considered in determining the accurate solution. It would be interesting to know this; possibly the error is still larger than indicated in this discussion.

C. M. Ashley, Syracuse, N. Y., emphasized that this paper was one of great significance for the Society, because it introduced a new technique for the solution of one of our most important problems on a sounder basis.

Mr. Ashley pointed out some of the distinctive contributions made by the paper. In the first place, the idea of combining the sun effect with the outside air temperature, to make an over-all picture as to the amount of heat conveyed to the outside of the wall, is, Mr. Ashley stated, a very significant contribution, and points the way to a means by which simplified expressions for practical use in the field can be derived using that same approach to the problem. Another contribution, he brought out, was the separation of the wall from the outside factors.

Some of the approximations that were shown in the paper are a little unfortunate, and, even since the paper has been published, the authors have found a means of overcoming that without involving too much extra work.

J. N. Hadjisky, Birmingham, Mich., stated that the seriousness of a problem of this kind came to his attention a year ago, when a large building had to be designed for industrial purposes, preliminary estimates calling for 3,000 tons of refrigeration. Two or three of the engineers were delegated to make an independent study, and the estimates differed by a very large amount, chiefly because unreliable information of volumetric capacities and other constants also varied by a very great deal. Fortunately, the refrigeration could not be secured in time, and the air conditioning was dropped out. Mr. Hadjisky inquired if the authors considered it feasible to use some method of artificially simulating the two input factors, the solar effect and the outside surface coefficient, and possibly by the plate method measure the volumetric absorption or storage of heat through the material.

H. B. Nottage, E. Hartford, Conn., explained that in regard to this problem of determining volumetric specific heat by means of some simple experiment the problem is quite simple. It has been done with a little box on a table in a very elementary and yet very precise manner. The work was set up as a student laboratory project by Professor Lumden of Stanford University in California. It is not necessary to reproduce a periodic fluctuation of temperature, he explained.

Mr. Wright expressed satisfaction in Mr. Nottage's comments, and stated that the physicist often measures the properties of steel bars in the way that was mentioned by Mr. Nottage.

Prof. F. E. Giesecke then presented his paper on Friction Heads Due to Water Flow in Copper, Brass and Other Smooth Pipes (complete paper published in November, 1942 Journal Section, Heating, Piping & Air Conditioning).

J. N. Hadjisky, Birmingham, Mich., asked the author if he was acquainted with published data developed during the last war in cooling airplane radiator work where the variation in temperature was abandoned and the mass of water or mass of air was taken, and it gave much more interesting results. He also asked in regard to the smooth pipe versus the rough pipe. Could the problem be considered this way, based on momentum and loss of momentum rather than more complicated figures of diameters and so on?

Dr. Giesecke stated that he was not prepared to answer either question, inasmuch as his work has been confined to the details explained.

Mr. Nottage said data on flow of oils with heat transfer superimposed indicate that the friction factor does depend upon the temperature level and rate of heat transfer, and data on air also indicate that the friction factor does depend upon the rate of heat transfer and temperature level in a way which cannot be predicated by any simple correlation. Mr. Hadjisky mentioned some work on airplane radiators just following the last war. Some work has been done on that problem and it is still impossible to completely answer questions involving the effect of temperature level in heat

transfer upon friction loss. There is a difference between hot and cold friction for the same mass flow, which is not explained solely in terms of viscosity and the effect, that is difference between hot and cold friction depends upon the roughness of the surface. These comments are offered in case others who are interested in similar problems may help and find the answer.

Dr. Giesecke then replied that the entire field is very important and very complicated, and needs considerable additional study.

In the absence of L. V. Teesdale, author of the paper, Comparative Resistance to Vapor Transmission of Various Building Materials (complete paper published in December, 1942 Journal Section, Heating, Piping & Air Conditioning) John James, Technical Secretary of the Society, made the presentation.

E. C. Lloyd, Lancaster, Pa., (Written): The long and thoroughly prepared background of Mr. Teesdale and the Forest Products Laboratory on vapor flow work is evident in this paper which constitutes a valuable contribution to the subject of vapor flow through building materials.

It seems to me that one point made by the author is worthy of particular emphasis. I refer to the statement "Apparently vapor transmission is not directly proportional to vapor pressure differences in all cases, particularly where materials that are hygroscopic are involved." Actually, the data in the paper as presented in Tables 1 and 2 are all presented in support of the first clause of the quoted statement, but to me there seems to be little that bears out the latter clause, though it is reasonable to suppose that the hygroscopicity of the specimen under test has a decided bearing on the rate of vapor flow. The particular significance to the writer is twofold—*first*, where experimental results are expressed on a unit basis; i.e., in grains per square foot, per hour, per inch of mercury vapor pressure, care should be taken to record the high and low vapor pressures and not alone the differential pressure and, *second*, where experimental results are expressed on a *condition of test* basis, as is the case here, record should be similarly shown of the high, low and differential vapor pressures prevailing in the test.

The author has given a figure of 0.600 grains per square foot per hour for the conditions of the test as representing the maximum vapor transmission allowable in a suitable vapor barrier. This might be expressed as 0.830 grains per square foot, per hour, per inch of mercury vapor pressure where the conditions prevailing are a temperature of 80 F on both sides of the specimen with saturated atmosphere on the one side and 30 per cent humidity on the other.

Referring to Table 2, it would seem that none of the samples tested showed either in the 30 per cent or 65 per cent room a resistance to vapor flow which satisfactorily meets the condition for a suitable vapor barrier of 0.600 grains per square foot per hour. This is rather surprising in view of the fact that relatively impermeable surface finishes were in place on one or both sides, and, further, the plywood had the several glue lines to supplement the outside seal. If possible, I should be interested to know the number of pieces and the type of glue used in the 5/16 in. plywood of Table 2, and, also, I should be interested to have a little further data on the six fiberboard sheathings reported on in the same table. At least, with respect to the sheathings, I would be interested to know whether the six samples represent one product as made by one manufacturer and if they are simply a fiberboard with a dipped or roller-coated asphalt surface on each face.

On the data in Table 3, a number of questions arise. It would seem that the heading of *Resistance Value Used* in the seventh column is badly chosen as these values are apparently vapor transmission values, and it would seem that a resistance would normally be the reciprocal. I would be interested in knowing if the vapor transmission values for the lath and plaster as recorded in the seventh column were determined, as with the vapor barriers, by a humid pan method in the 80 F—30 per cent room or if they were determined by actual exposure which would involve a temperature gradient as well as a vapor pressure differential.

H. E. Lewis stated that the author provides some helpful data, but does not identify the materials by name or description to be useful in applying it. He further commented that the various authors of vapor transmission studies should get together on a common test method and a common method of specifying units of transmission.

Mr. Hadjisky described a method used to eliminate moisture in a storage room and also an experiment he conducted with a small glass chamber which convinced him that investigation into the partial pressure affecting diffusion of light gases was needed and especially condensation in houses, which he thought was greatly influenced by the cracks around windows.

C. H. Randolph, Milwaukee, thought that the column headings of Table 1, pp. 737 and 738, should show weight per roll 500 sq ft rather than 500 lb.

A. S. Bull, Minneapolis, commented that the work on vapor transmission has been of great interest to makers of insulating board products, but he thought it unfortunate that much laboratory work had to be curtailed due to war conditions, but he indicated that work on the subject was continuing at the University of Minnesota. It was his opinion that the test could be translated into terms for field use, and he considered it desirable to adopt a uniform method of reporting results so that comparisons of the work of different investigators could be readily made.

The session adjourned at 12:05 p. m.

Fourth Session—Tuesday, January 26, 2 P.M.

With First Vice-President Blankin presiding the fourth and final session of the 49th Annual Meeting was called to order at 2:00 p. m. and F. C. McIntosh, as Chairman of the Committee on Research, was introduced and presented his report (complete report published in February 1943 Journal Section, Heating, Piping & Air Conditioning).

Chairman Blankin complimented Mr. McIntosh on behalf of the Officers and Council for his excellent report and extended the thanks of the Society to the Committee on Research for the fine work that had been done during the past year, under conditions that were exceptionally trying.

Chairman Blankin then presented greetings from the National Warm Air Heating and Air Conditioning Association which were sent by H. S. Sharp, President; George Boeddener, Managing Director, and F. G. Sedgwick, Chairman of the Association's Research Committee.

Second Vice-President Downs assumed the Chair and presented Lt. Comdr. F. C. Houghten, who gave the next paper, Physiological Reactions Applicable to Workers in Hot Industries, by F. C. Houghten, Carl Gutberlet and M. B. Ferderber (complete paper and discussion to be published in April 1943, Journal Section, Heating, Piping & Air Conditioning).

Chairman Blankin resumed the chair and introduced W. T. Jones, Boston, Past President of the Society who with the assistance of Past Presidents Fleisher and Giesecke, conducted the Installation of Officers.

President Blankin responded briefly and was presented with the gavel. He then called upon Dr. C.-E. A. Winslow, New Haven, Second Vice-President of the Society, to conduct the panel discussion on How to Keep Fit in Cold Homes. Dr. Winslow called the roll of the panel members as follows:

Dr. C. A. Mills, Medical School, University of Cincinnati, Cincinnati, Ohio—Physiologist;

Major W. J. McConnell, Medical Corps, Ordnance Department, 333 N. Michigan Ave., Chicago, Ill.—Physician and Public Health Officer.

Mrs. Ivah Deering, 1118 Cypress Ave., Cincinnati, Ohio—Housewife;

Mr. E. K. Ruth, Manager, English Woods, 1990 Sutter Ave., Cincinnati, Ohio—Housing Manager;

Mr. Robert Davison, Director of Research, John B. Pierce Foundation, New York City;

Mr. R. A. Sherman, Battelle Memorial Institute, 505 W. King Ave., Columbus, Ohio—Bituminous coal;

Mr. Allen Johnson, Representative, Anthracite Industries, Inc., 405 Lexington Ave., New York City;

Mr. A. Stanley Bull, Insulite Co., Minneapolis, Minn.—and chairman, Technical Committee, Insulation Board Institute.

Chairman Winslow opened the discussion by stating that it would be an informal round table talk in which the mem-

bers of the panel will participate and at suitable intervals discussion will be open to those in the audience. First, he requested the testimony of panel members on the subject: How to Keep Fit in Cold Homes.

Mrs. Deering responded by saying that the problem in Cincinnati was somewhat different from the Eastern Seaboard and her recent investigations revealed that homes in the vicinity had mean temperatures around 70 to 71 degrees, that public buildings have not lowered their temperatures and a survey indicated that 25 public buildings during the past week showed an average temperature of 79 degrees.

Mr. Bull said that a temperature of 31 deg below zero was experienced in Minneapolis earlier in the week and that inside temperatures were lower where people used rationed fuel while those burning unrationed coal and gas were maintaining 70 to 71 degrees.

Mr. Davison said that a test in a Bronx apartment housing 5,000 people in 1,415 rooms had shown an average temperature of 66.7 degrees with auxiliary heating in use. He indicated that an analysis of temperatures and fuel consumption would indicate that during January and February an average temperature of about 60 would be maintained if one-third of normal fuel oil was available. It was his opinion that if one-third less fuel were burned either in apartment houses or most single family houses, it would be impossible to maintain a 65 degree temperature. He thought that the 65 degree temperature which had been used in connection with fuel oil rationing was a serious mistake and ought to be corrected by the agencies responsible. New York apartment dwellers have called health authorities when 65 deg is not maintained in their apartments and the owner is called into court and fined. If a third of the normal fuel oil must be saved it is impossible to maintain the required 65 degrees.

Chairman Winslow indicated that he burned 6,200 gallons of oil last year and his allotment was 3,400 for this year. His thermostat setting was 58 in the daytime and 52 at night and it was possible to keep one room comfortable by using a coal grate.

Major McConnell said that temperature had been greatly over-emphasized and that people who expected to maintain a 65 degree temperature with the amount of fuel oil given to them had been unable to do so.

R. K. Thulman, Washington, D. C., thought that the discussion was getting into the fuel oil rationing method which could not be outlined in three minutes. He stated that publicity of OPA had not contained references to the 65 deg temperature as being possible under fuel oil rationing.

Chairman Winslow explained that there was no intent to give the impression that the Government had guaranteed a 65 degree temperature under fuel rationing, but statements made by its various spokesmen on fuel oil rationing had given the general impression that 65 degrees was what people could expect.

E. K. Campbell, Kansas City, Mo., made the statement that the 65 degree temperature is made official in the auxiliary rationing form issued by OPA.

Chairman Winslow said that the next question that suggests itself was the prospects of relief in the shape of additional fuel oil and the answer indicated is no, so that consideration should be given to the alternatives that are available in connection with the coal supply in regions that are now short of oil.

Mr. Johnson said that it is possible for the anthracite industry to supply sufficient coal to meet all demands. The industry, however, cannot plan ahead because there is no settled policy with respect to conversions. The response to the campaign to buy coal last summer was very successful. The essential need is to permit the industry to adopt an orderly plan of production rather than work on a hand-to-mouth policy.

Mr. Sherman indicated that the bituminous coal situation was comparable to conditions in the anthracite field. The campaign last summer to have both domestic and industrial users store coal was very effective and the bituminous industry made an all time production record. The New England area seemed to be the critical one and transportation is the key to the situation.

Mr. Johnson expressed the opinion that the 1943-44 heating season will be the most critical and that definite plans and policies should be made now to enable the fuel industry to foresee what is required, as production could not be stepped up at a minute's notice. He expressed the opinion that unless compulsory conversion was required no one would do anything after March 15, particularly if they had struggled through the winter with supplementary heat, shut-off rooms and other privations.

Mr. Thulman said the Government was being criticized for not requiring householders having grates to convert, or under certain other specified conditions, when as a matter of fact the Government has been able to find no legal way for carrying out such a program.

It was Mr. Johnson's opinion that there are 300,000 or more homes with available grates and some way should be found to put them into service.

Mr. Thulman explained that a householder has the inalienable right to freeze himself to death if he wants to and while the Government could legally restrict or limit the amount of fuel oil he can purchase, there is no way to force conversion to another fuel whether or not he has grates in the basement.

Mr. Sherman asked the question whether all commercial or industrial users of fuel oil have been compelled to convert, so that the equivalent amount of oil could be given to homes.

Chairman Winslow thought it would be possible for the Government to announce as a policy that fuel oil rations would not be provided for persons who could not prove that it was impossible or too expensive for them to convert to another fuel.

Mr. Johnson's belief was that if fuel oil could be denied to commercial users it could be denied to domestic users, and he also thought that a home owner should be required to choose whether he wants petroleum products for his automobile or his oil furnace.

Chairman Winslow thought it was too late now to do very much in the way of conversion of heating equipment, but said that if the speakers are right, it can be assumed that this problem will be even more serious next year and he felt that anything that can be done legally to stimulate conversion should be done.

J. C. Miles, Cleveland, Ohio, offered the suggestion that anthracite fuel should be sold in a form that would make its use more economical and efficient. He considered great progress would be made if the larger sizes of coal were eliminated.

Mr. Harvey said that there are millions of tons of very good bituminous coal that could be used in fireplaces and he thought that it would be advisable for people to use some of it rather than cannel coal, which not only has a high ash content, but is also one of the smokiest.

Mrs. Deering asked if it is true that the offices in public buildings and apartment houses in the middle west are still overheated, while those on the east and west coasts need heat. She wondered whether the amount of coal could be limited in the middle west if people are using it extravagantly.

Mr. Sherman indicated that the matter of supplying coal in the middle west was not a serious problem, but it might be desirable to reduce temperatures and avoid overheating.

Mr. Bull said that most of the discussion had centered around coal and oil, and pointed out that in Minneapolis, a large percentage of the homes are gas heated, while in the rural areas wood is used extensively.

Chairman Winslow said that the discussion indicated that a substantial proportion of homes on the east and west coasts will be cold for the next six or eight weeks, and many will probably be cold next winter. The question now arises, what can be done about it?

Mr. Bull then presented figures from the University of Minnesota and the U. S. Bureau of Standards, which showed possible savings in the annual fuel bill ranging from 10 to 60 per cent by the use of weather-stripping, double windows, and by insulation of various thicknesses. He said that one of the main bottlenecks was the shortage of skilled labor, and another factor was the time required to make any structural changes. In an emergency he said the application of insulating material over single glazed windows had been used and he indicated that the saving, in the temperature zone of Chicago, was approximately 1 gal of fuel oil per square foot of glass surface.

Mr. Davison thought that such application on south windows would hardly show the saving indicated.

Another translucent material often used in greenhouses

was mentioned by Mr. Johnson for application over windows.

Mr. Thulman said that he had used solid panels over his windows and he indicated that the cost of covering 150 sq ft of window surface and door area was less than $10.00.

Mr. Sherman thought that the use of solid panels would require greater use of lights, although we are urged to conserve electric power.

Mr. Downs thought that savings as high as 60 per cent were too optimistic.

Wharton Clay, New York, N. Y., brought out the point that mineral wool had solved the problem for many houses already built, and he said that of the 2,400,000 houses in 33 states heated with oil, over one million have no insulation, according to Government estimates.

W. L. Fleisher, New York, N. Y., considered that the greatest public interest in the subject of heat reduction was from the health standpoint and he thought that people would have to adjust themselves to lower temperatures.

Chairman Winslow then said that the term *cold* must first be defined.

Dr. Mills offered the thought that a person is cold when he begins to shiver. "I mean," he explained, "that when a persons feels cold it is time to put on more clothes, or poke up the fire." He believed that more clothing was the easiest means of providing relief to the American people in the fuel crisis. He thought that health would be improved if people were to adapt themselves to lower indoor temperatures. The British principle of providing lower indoor temperatures, lessened the contrast between inside and outside, and they wear almost as much clothing indoors as they do outdoors. The American people have gone in another direction and have built up indoor temperatures to 80 deg, so that they take off clothing indoors. The result is that respiratory ailments are common. He warned against chilling, because it promotes respiratory infection, and he said that living in cold houses should require more clothing, particularly of the extremities.

Major McConnell said that before reaching the point of shivering there are several general principles which can be used to improve room conditions.

Mrs. Deering thought that Dr. Mills' observation that silk stockings had no place in cold homes, would be rather hard on the women. She also pointed out that English women take a great deal more exercise than American women.

Chairman Winslow said that the human body is like a house, as thermal changes depend upon how many changes are put into the house, and how much heat gets out. He said that with a given activity there is a wide range of temperature adaptation depending upon the clothing worn. He said that experiments had shown a minimum comfort temperature of 72½ deg for a man in a light summer suit and light underwear, of approximately 2.9 lb of clothing, but a man in a heavy golf suit with heavy woolen underwear was comfortable at 57.5 when at rest.

Mr. Davison brought out some results from a recent clothing study developed at the Hillside Apartments in The Bronx, New York, which showed that in 45 families 42 women made adjustments in daytime clothing, while 25 men made adjustments during the same period. He stated that adjustments were also made at night with 35 women and 16 men using additional sleeping garments.

Mr. Ruth stated that in two projects that were almost identical, each containing 750 families, every possible precaution had been taken to save fuel and all ceilings had been fully insulated. Last summer an attempt was made to find out what standards should be used for winter operation and he thought that there was no Fahrenheit temperature that corresponds to a health or comfort condition.

Mr. Ruth explained that each heating system serving three buildings supplied an average of 30 families, composed of young and old. He also stated that an educational campaign had been conducted among the tenants and he found that they were giving a high degree of cooperation.

Chairman Winslow pointed out that one method of adaptation to meet special conditions was local zone radiant heating.

C. A. Dunham, Chicago, Ill., said that one factor that had a direct bearing on the amount of heat necessary for comfort was humidity, and he advised that he was perfectly comfortable at 65 deg in London and also in California, but in Chicago where it is rather dry in the winter months it takes a higher temperature to produce equal comfort.

J. N. Hadjisky, Birmingham, Mich., told of his experience with 25 American engineers who went abroad, where the temperature in the winter was from 20 to 30 below zero from Christmas to March, and he further stated that in November the windows and storm sash were puttied inside. He stated that even though supplementary radiant heaters were used and long heavy underwear was worn, the temperatures varied from 45 to 57 deg in the drafting room, and people sitting close to the outside windows found it difficult to use drawing instruments.

Mrs. Deering wondered whether there was serious danger in sleeping with windows closed, especially if various suggestions for sealing windows were carried out.

Chairman Winslow thought some of the traditions and superstitions might be discarded, although many people found it more comfortable to sleep with some air movement in a room. He indicated that many people who now live in modern housing projects have previously been trained by visiting nurses that they must have windows open in the bedroom for an hour, a tradition that goes back to the days when people never washed and it was necessary to air out.

Mr. Ruth stated that people were now getting over the habit of opening windows, and they are becoming more careful about leaving doors open and running to see the next door neighbor.

Mr. Clay inquired about the effect of wearing heavier clothing with conditions of varying temperature.

Chairman Winslow stated it was a serious problem and there has been much discussion of the subject of temperatures below the ideal optimum, but as Dr. Mills and Major McConnell had pointed out, the mass of evidence shows that people's health, comfort and efficiency are damaged by overheating.

C. H. Randolph, Milwaukee, Wis., indicated that his personal experience showed an improvement of health as a result of sleeping in an unheated room and he related an experience in connection with fuel oil rationing which indicated the large consumption of oil in some of the old homes, and a small consumption in homes where space heaters are used.

Dr. Mills brought out the point that it was not necessary to keep temperatures up in the 70's to keep it comfortable for the child under three or for the older person, even though they are producing less heat than an older child or a younger person, but the main thing in this emergency period, when fuel is scarce, is to wear adequate clothing. Just how much clothing depends upon the individual based on their own heat production, amount of activity, etc.

Mr. Johnson in expressing a final comment felt that temperature is not very important, so far as health is concerned, because our homes not so very many years ago were fitted with fireplaces and stoves. However, insofar as comfort is concerned, and the preference of the American people, 70 deg has been chosen as the most desirable for comfort.

Mrs. Deering further commented on the open window proposition, stating that even a one inch opening would help, but she did not believe in closing the windows entirely.

Chairman Winslow in concluding the discussion pointed out that certain things were brought up and very clearly stated, that the oil burning family is likely to be in a bad way, that nothing much is likely to happen about conversion and insulation during the summer, unless the Government gets stricter with its rules and regulations concerning this problem. Chairman Winslow reiterated that matters of clothing and of adaptation are of immense importance. He also felt that whatever could be done to emphasize the importance of adequate clothing and the importance of adaptation to somewhat lower temperatures than have been customary will be of great advantage. He also felt that the American people will find that they will

be much better off during this period with homes at lower temperatures than those they have been accustomed to. He felt that the overheating of the American homes has been a rather serious factor, and also felt that some concrete benefits might come out of this present emergency.

Report of Resolutions Committee

Be It Resolved, that the American Society of Heating and Ventilating Engineers appreciates to the fullest the inspirational leadership of President E. O. Eastwood, who unfortunately cannot be present today. His stirring annual report is read with keen interest, and we as members of this Society accept with enthusiasm his challenge to a rededication to the service of building a stronger and more useful organization, which has reached the heights under his leadership during the eventful year of 1942.

Whereas John James, who has so faithfully served the Society for the past seven years, has moved on to greater opportunity and responsibilities,

Be It Resolved, that we wish him the greatest success and happiness in his new work.

Whereas the Society as an organization and through its members as individuals desires to make its services freely available to the nation in this war period, and

Acting on this principle, the President has appointed a War Service Committee to represent the Society in making this assistance available, and

Whereas the activities of this committee have included the encouragement of war-related research, collaboration with Government agencies, in the study of fuel rationing, sponsorship of conferences aimed to assist intelligent administration of the rationing program, publication and distribution of special suggestions for fuel conservation in the home, and encouragement of local chapters and members to assist the war effort wherever possible, and

Whereas it is believed that these efforts have been generally successful and that they represent an appropriate attitude on the part of the Society,

Therefore, Be It Resolved, that this action of the Society be endorsed, and that the President and the Council be urged to continue effective war service to the nation by the activities outlined and by similar activities which may be indicated as desirable in the changing conditions of wartime.

Be It Resolved, that the Society expresses its appreciation to Fabian C. McIntosh, for the outstanding job accomplished as Chairman of the Committee on Research, and be it further resolved that as this work, which is of the utmost importance to the success of the Society, has been ably supported by an outstanding group of men, who literally anticipated President Eastwood's challenge to a rededication to the service of building a better, stronger, and more useful organization, we heartily commend their efforts.

Whereas the 1943 Edition of The Guide speaks for itself, and is an everliving symbol of the tremendous task performed by its able Chairman, A. J. Offner, who, with his many associates, has produced an outstanding reference book of facts developed by the very best brains in our profession, Be It Resolved that they receive our grateful thanks for their services, and Be it further resolved that the cooperating educational institutions who have so generously participated in research projects sponsored by the Society receive our thanks for their work which is the fundamental basis of the continuing success of the Guide and our Society.

Also Be It Resolved that the Committee on Admission and Advancement, Chairman Earle W. Gray, E. P. Heckel, and T. T. Tucker, be commended for their untiring efforts and investigation of new applicants to accord them the membership grades to which they are entitled by the rules of this Society, a truly difficult but important task, which they have discharged with success.

Now Whereas, the Forty-Ninth Annual Meeting of the ASHVE is to be concluded tomorrow, without any further general sessions, and

Whereas, the technical sessions, the entertainment, committee meetings, and business transacted, have been of unusual interest and exceptionally stimulating to those in attendance,

Be It Resolved, that an expression of thanks and appreciation be adopted, and copies of these resolutions be published and sent to each of the persons and agencies who have contributed toward making this 49th Annual Meeting so enjoyable:

To E. O. Eastwood, the retiring President and the National Society officers and committees who devoted so much of their time and energy to the work of the Society during the past year;

To the Officers and Members of the Cincinnati Chapter and their ladies who have welcomed everyone with a cordial hospitality ever to be remembered;

To Honorary Chairman W. C. Green, General Chairman A. C. Buenger, and Ladies Chairman Mrs. G. B. Houliston, who have been most considerate of our every wish;

To the chairmen and members of all other committees of Cincinnati Chapter who have given so generously of their time to assure the success of the program;

To the authors and their associates who prepared and presented the fine technical papers, so outstanding in their scope;

To the management and the staff of the Hotel Gibson and the Hotel Netherland Plaza for their fine cooperation and service;

To the Cincinnati newspapers for their excellent coverage of this meeting, and to the trade magazines who have cooperated so ably and so generously;

To Fred F. McMinn, President of the Engineers Club of Cincinnati, for his inspiring talk;

To John F. Collins, Jr., for his very able handling of the Chapter Delegates Conference and the work therewith, and for so generously accepting a continuation of this important assignment.

Whereas, Dr. Baldwin M. Woods, a member of the Resolutions Committee, having already left for the West, the two remaining members therefore have drawn up another resolution, as follows:

Be It Resolved, that a vote of thanks be extended to Dr. Baldwin M. Woods for his very interesting, informative, and inspiring talk at the Joint Engineers Luncheon on Monday.

Mr. Chairman, I move the adoption of the report of the Committee and the supplementary resolutions.

. . . The motion was seconded by Mr. Avery and unanimously carried . . .

Entertainment

Promptly at noon on Monday, January 25, members of the Engineers Club of Cincinnati gathered with Society Members for a Joint Luncheon in the Ballroom of Hotel Gibson. Over 300 were in attendance to hear Dr. B. M. Woods, Professor of Mechanical Engineering, University of California, Berkeley, speak on the subject of The Manpower Problem in Engineering. Fred F. McMinn, President of the Engineers Club of Cincinnati acted as toastmaster for the occasion.

In his talk Dr. Woods covered the following phases of the man power problem in engineering:

The role of the engineer as related to science and industry; the process of invention and development; inventions that have gone to war; the number of engineers required; types of young engineers in greatest demand; the place of older engineers today; methods of meeting engineering requirements through accelerated college programs and army and navy training programs; the estimated needs for the coming year in manufacturing, construction, mining, teaching, utilities and federal, state and local government departments; the post war problems of demobilization and the effect of transition from war to peacetime requirements.

On Monday evening, the Entertainment Committee provided a dinner and ice show in the Continental Room of the Netherland Plaza Hotel. A most enjoyable evening was spent by the 324 members and ladies who attended and G. B. Houliston and his Committee received many compliments on the success of this party.

The 49th Annual Banquet was held in the Roof Garden of Hotel Gibson, on Tuesday evening and the Honorable Russell Wilson, a member of the City Council and former Mayor of Cincinnati presided as toastmaster. The honored guests at the head table were: Russell Wilson, Col. W. M. Carey, President and Mrs. M. F. Blankin, Mr. and Mrs. William Green, 1st Vice-Pres. S. H. Downs, Treas. E. K. Campbell, Brig. General and Mrs. W. A. Danielson, Mr. and Mrs. A. L. Hard, Mr. and Mrs. Albert Buenger, 2nd Vice-Pres. C.-E. A. Winslow, Mr. W. H. Driscoll and Lt.-Comdr. T. H. Urdahl.

The speaker of the evening was Col. W. M. Carey of the Corps of Engineers, U. S. Army and Chief Engineer for the Federal Works Agency, Washington, D. C.

J. H. Walker

F. C. McIntosh

Plaque presented to J. H. Walker

He briefly reviewed the achievements of the past year in creating a large fighting force and the more cheerful viewpoint that is apparent now compared to a year ago. He then referred to some of the economic conditions that existed in the 1920's and 30's and indicated that encouragement and confidence must be given to business through some established policy for the post war period. He stated that the kind of planning we need will start with a national survey of needed public works. A construction program, he stated, required planning and this takes time, so if we wait until the end of the war before we draw up plans and write the specifications, there will be unemployment for many months before worthwhile public projects can be started. He felt that any plans should be flexible so that they can be adapted to changing conditions. He also stated that 17½ billions of dollars from 1933 to 1941 have been spent for work relief of various sorts, and a large part of that sum was the price paid for failure to plan in advance. He also stated that if plans were carefully made, much less than the sum being spent for war in the month of January, 1943, would be ample to make good for many years to come the promise that every man shall have a job.

He concluded by saying that, if by planning, a war over foreign tyrants can be won, it is also possible by planning to win the war against the tyrannies of depression, want and misery at home.

W. H. Driscoll, Past President of the Society introduced President M. F. Blankin, who announced that the Society had a total of 81 Life Members and after reviewing some of their professional achievements, he presented Life Membership Certificates to Dr. W. H. Carrier, Syracuse, and Professor Perry West of the University of Kentucky, Lexington. Mr. Carrier expressed his appreciation for the honor conferred and read a brief statement of thanks by Prof. West.

F. C. McIntosh, Chairman of the Committee on Research, presented a resolution adopted by the Committee on Research, in recognition of the services of J. H. Walker, Detroit. Mr. McIntosh then presented Mr. Walker with a handsome plaque for his service as Technical Adviser to the Committee on Research.

The Members of the Committee on Arrangements of the Cincinnati Chapter were requested to stand and the visiting members applauded them for their hospitality and the fine program of entertainment.

Following the banquet the members and ladies enjoyed dancing to the music of Jimmy Wilber and his orchestra.

Under the direction of Mrs. G. B. Houliston, the visiting ladies were entertained during the meeting with a Dessert Bridge on Monday afternoon at the Hotel Gibson and on Tuesday a special luncheon and style show at John Shillito & Co. store.

On Sunday evening, January 24, the Past Presidents of the Society gathered for their annual dinner at 6:30 p. m. and the following were present: Dr. W. H. Carrier and W. H. Driscoll, Syracuse, N. Y.; W. L. Fleisher, New York; Dr. F. E. Giesecke, Urbana, Ill.; E. Holt Gurney, Toronto; W. T. Jones, Boston; and J. F. McIntire, Detroit.

Chapter Delegates Conference

At 7:30 p. m. on Sunday evening, the Chapter Delegates Conference was held in Parlor H of the Hotel Gibson with John F. Collins, Jr., presiding. The following Chapter representatives answered the roll call: T. T. Tucker, and L. F. Lawrence, Jr., Atlanta; A. L. Hard, Cincinnati; L. E. Seeley, Connecticut; G. E. May, Delta; B. M. Woods, Golden Gate; E. M. Mittendorff, Illinois; F. E. Triggs, Iowa; L. T. Mart, Kansas City; Ivan McDonald, Manitoba; E. G. Carrier, Massachusetts; M. B. Shea and R. E. Olds, Michigan; W. McNamara, Minnesota; G. P. Ste Marie, Montreal; B. G. Peterson, Nebraska; C. S. Koehler, New York; F. E. P. Klages, North Carolina; T. H. Anspacher, North Texas; P. D. Gayman, Northern Ohio; E. T. P. Ellingson, Oklahoma; H. R. Roth, Ontario; B. W. Farnes, Oregon; R. D. Morse and E. H. Langdon, Pacific Northwest; H. H. Mather and E. Elliot, Philadelphia; E. H. Riesmeyer, Jr., Pittsburgh; C. F. Boester and M. F. Carlock, St. Louis; J. A. Walsh, South Texas; F. A. Leser, Washington, D. C.; C. H. Pesterfield, Western Michigan; H. C. Schafer, Western New York, and C. H. Randolph, Wisconsin.

MESSAGE TO ALL ASHVE MEMBERS

We feel grateful to the men who invited us to join our Society over 20 years ago.

At one of our meetings, the banquet speaker compared Societies like ours to University Extension Courses, and we can testify that it has been, because it has kept us awake, alert, and abreast of the times and developments.

Any man should feel grateful for being invited to join a Society that does that. When you invite him to join, you are not asking him a favor, you are doing him one.

Due to service of members in the Armed Forces, resignations, and other reasons, the Society lost some members last year. Let us make up the loss this year. There are many men ready to join who require a little pushing. Let every member push just a little so as to get 50 applications before the first of April.

W. A. RUSSELL,
A. J. OFFNER,
E. K. CAMPBELL, Chairman.

Some Engineering Problems of the New Vegetable Dehydration Industry

By W. B. Van Arsdel,* Albany, Calif.

SUMMARY—**War time conditions have introduced a number of new dehydration systems for the drying of foods. Six essential specifications which should be considered in the design of a dehydration system are outlined. Complete new data on vegetable dehydration with charts showing the drying rates are included. Due to the war program emphasis is placed upon the design of equipment that requires less man hours of skilled labor in fabricating the necessary equipment. Individuals doing work in this field are urged to make use of the enormous amount of data in the various Government and State bureaus**

DURING THE past year a renaissance of the vegetable dehydration industry has brought into being scores of new dehydration systems and a large number of more or less radical modifications of conventional types of dehydraters. A good many processes conceived during the great dehydration boom of 25 years ago are now being resurrected; once again there is a market for novel ideas. There are many concerns that now wish to install dehydraters, but have only vague notions about what a good dehydrater should be. Almost any system, no matter how fantastic, may be reasonably sure of a respectful hearing.

Heating and ventilating engineers know that there are exact physical laws which describe accurately the operation of every dehydrater. These laws may be complex, but there is no mystery about the conservation of mass and of energy and the second law of thermodynamics, which rule in this sphere as they do in all physical processes. Any competent engineer can, by the use of these laws and by application of his knowledge of the properties of water and of air, calculate what the top performance of any particular dehydrater can possibly be. No more than that is needed to deflate the pretensions of some of the more inept of the current dehydrater designs.

Much more is needed at the present juncture, however, than the mere weeding out of mistaken or extravagant systems. The whole matter of dehydrater design and construction is in a state of flux and rapid development, and there is great need for the immediate application of the highest type of engineering talent to this problem.

*Principal Chemical Engineer, Bureau of Agricultural Chemistry and Engineering, Agricultural Research Administration, U. S. Department of Agriculture, Albany, California.

Presented at the 49th Annual Meeting of the American Society of Heating and Ventilating Engineers, Cincinnati, Ohio, January, 1943.

Complete Plant Design Needed

In the first place, much more attention needs to be paid to well-rounded and complete plant design. It should not be forgotten that the dehydrater is only one piece of equipment in a production line which must work as an integrated whole. In some important respects it would be preferable to tailor the dehydrater to fit the requirements of the rest of the operation, rather than to build the whole plant around the dehydrater. Today there are very few engineering firms, consultants, or equipment concerns that confess to broad enough competence to undertake this integrated plant design. And yet it is certain that within the coming year or two there will be hundreds of plants in the United States which will need that kind of service. Without it there will surely be numerous cases of serious unbalance, waste of equipment and materials, and failure to reach production goals.

Within the more narrow field of the design of the dehydrater itself a great deal needs to be done, and time presses inexorably. In spite of the great amount of high grade work done in the past, as evidenced by hundreds of publications and patents, two circumstances have reopened the whole subject. One is the impact of a wartime scarcity of materials and equipment, the other is the appearance of much new knowledge about the manner in which various vegetables dry and the effect of processing methods on the quality of the product.

Wartime Adaptations

The economic consideration is substantially different from what it would be in time of peace. Equipment cost must now be weighed with less regard to dollars and more regard to pounds of steel and man-hours of skilled fabricating labor. One consequence is an intensive drive to adapt existing dehydraters of many types to this new job. Some converted fruit dehydraters are performing very well. Some others are relatively ineffective. There is room for high class engineering in the modification of such equipment, and in the adaptation of numerous driers in other industries whose operations have been curtailed because of the war. Another consequence is that great emphasis must be placed on such rational design of dehydraters as will assure the absolute maximum of output from each unit consistent with high quality of product. This demand has led to the rapid development of multi-stage dehydration processes in which the equipment in each stage is matched with the drying characteristics of the material. This development will be discussed at greater length later in this paper.

Some of the other traditional economic yardsticks suffer a change of scale because of the war. Local circumstances of fuel shortage or scarcity of labor may have a powerful effect on design. If fuel supply is not a serious bottleneck, the pressure for production is likely to make fuel economy unimportant.

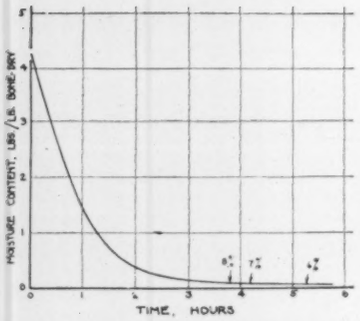


Fig. 1—Typical vegetable drying curve

Russet potato, blanched 5/32-in. strips, wood-slat tray, load 1.5 lb per square foot, cross-circulation, air velocity 500 fpm, air temperature 150 F, wet-bulb temperature 90 F.

The same thing is true of power usage.

New Data on Vegetable Dehydration

During the past two years a great body of specific knowledge about vegetable dehydration has been built up. This knowledge may be divided into two distinct, but interrelated, fields — information about drying rates and information about the effects of processing methods on product quality.

Past work on the design of vegetable dehydraters has had to be conducted without benefit of exact data on the drying rates of vegetables. This information is rapidly becoming available. As anyone who has ever tried to design a dehydrater knows, the general physical laws of thermodynamics and of air circulation are only a part of the information needed—a necessary part, but not sufficient. In addition the designer needs to know how fast the moisture will evaporate from the product, and what the relation of that rate is to all of the pertinent variables. It is only as he applies such knowledge that he is able to make really effective use of the materials and equipment at his disposal.

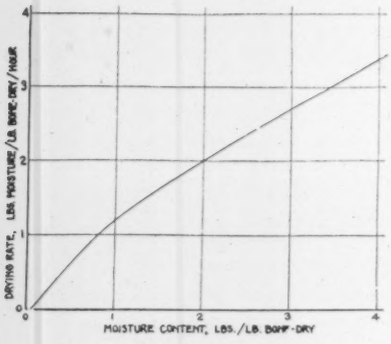


Fig. 2—Drying rate curve

Russet potato, blanched 5/32-in. strips, wood-slat tray, load 1.5 lb per square foot, cross-circulation, air velocity 500 fpm, air temperature 150 F, wet-bulb temperature 90 F.

The evaporation of water from a mass of cut pieces of vegetable involves a complex train of phenomena. Within the pieces moisture must diffuse through cellular tissues which change in properties as the drying progresses. Sugars and other soluble substances become more and more concentrated, the vapor pressure of the solution falls, and its viscosity rises. Shrinkage in dimensions is high and nonuniform. The situation is so complicated that theoretical analysis has not been very helpful and it has been necessary to depend almost entirely on experimental methods which simulate commercial conditions as closely as possible.

Drying Characteristics of Vegetables

If drying conditions are maintained constant, the loss of weight of a trayful of cut vegetable pieces follows some such course as the curve shown in Fig. 1. This curve is typical in two respects, namely, the very rapid initial rate of loss of moisture, and the very slow final approach toward an equilibrium moisture content. All of the experimental results obtained with the common vegetables have exhibited these same characteristics. Any dehydration system which fails to take these two characteristics into account fails, except accidentally, to attain real effectiveness.

Data on drying rates have commonly been analyzed by plotting the instantaneous rate of drying against the moisture content. Fig. 2 shows the curve which results from that method of handling the same data given in Fig. 1. The rate of drying falls continuously as moisture content falls. Contrary to experience in the drying of some other wet materials, there is no phase during which the drying rate remains constant, and the curve cannot be expressed at all accurately by one or two straight lines. Intensive study of a large number of drying curves of this kind has led us to the belief that they are not well adapted to the formulation of such general expressions for drying rate as the designer really needs. The main difficulty is that the precision of estimate of drying time from such a curve falls rapidly in the lower part of the curve. Since most of the time required for drying will be consumed at these low drying rates, the lack of precision in the estimate may be serious.

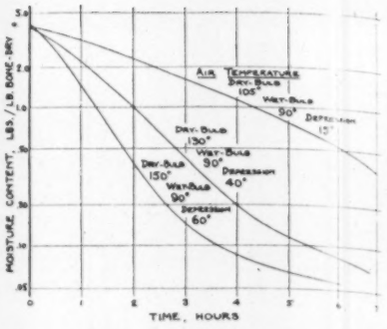


Fig. 3—Drying curves at different wet-bulb depressions

Russet potato, blanched 5/32-in. strips, wood-slat tray, load 1.5 lb per square foot, cross-circulation, air velocity 500 fpm.

We have found it more profitable to correlate such data as those of Fig. 1 directly, instead of using the instantaneous rates. Even at best, this correlation is a complex procedure, involving the separation of at least nine independent variables.[1] Only a progress report on the work can be made at this time. As promptly as possible, completed segments of the investigation will be published.

Fig. 3 compares a group of drying curves in which the independent parameter is wet-bulb temperature depression. The curves are straightened out materially by plotting on semi-logarithmic paper.

[1]Variety of vegetable, method of preparation, shape and size of pieces, thickness of layer, type of tray or other support, mode of exposure to the air stream, temperature of air, humidity of air, velocity of air, and others of less importance.

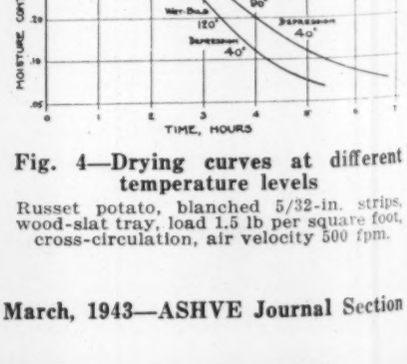


Fig. 4—Drying curves at different temperature levels

Russet potato, blanched 5/32-in. strips, wood-slat tray, load 1.5 lb per square foot, cross-circulation, air velocity 500 fpm.

As might be expected, more rapid drying is associated with higher wet-bulb depression.

Fig. 4 compares two drying curves in which wet-bulb depressions are equal but temperature levels are different. Drying is more rapid at the higher temperature level.

Fig. 5 compares a group of curves in which the only difference is air velocity across the tray on which the material was spread. Drying is more rapid at the high air velocity, but the effect is confined almost entirely to the upper portions of the curves, that is, the high-moisture portion of the run.

Fig. 6 compares curves from three runs in which the weight of loading of the moist material on a unit area of the tray was varied. The retarding effect of heavy loading is apparent.

Fig. 7 compares drying curves on several different vegetables, all under approximately the same drying conditions.

Fig. 8 indicates the degree of difference in drying rate between a typical fast-drying vegetable (cabbage), a slow-drying one (sweet-potatoes), and a stone fruit (prunes).[2]

We have been expressing our correlations of the effects of different variables both through empirical equations and through nomographs. A nomograph has advantages both in the ease of its use and in the fact that its scales may be drawn only as far as the experimental data themselves go, so that unwarranted extrapolation is discouraged. Fig. 9 is one such nomograph, still incomplete in the important region of low moisture content.

[2]Taken from Some Developments in Fruit Dehydration, by Rene Guillou; Agricultural Engineering, December, 1942.

Effects of Drying Conditions on Quality

Our knowledge of the effect of drying conditions upon the quality of the dry product is also much more comprehensive than it was two years ago.[3] While investigations are still far from complete, for these relations are much more complex than those involved simply in the rate of drying, certain generalizations may be made with confidence:

1. Rapid dehydration favors high retention of product quality.

2. Damage to quality is a composite effect of time and temperature; the coefficient of the temperature effect appears to be considerably higher than the doubling in each 10 deg C which characterizes many chemical reactions, so that there is a decided appearance of a limiting, or *critical*, temperature for safe operation. The important temperature is, of course, that of the material itself, not that of the air. There is some evidence that temperature damage may occur during any stage of the drying. The *critical* temperature of damage varies with the variety, maturity, length of storage, method of preparation, and possibly other factors.

3. Loss of quality during storage after dehydration is highly dependent on moisture content. The quality of a vegetable stored at 2 per cent moisture for 6 months may be substantially higher than that of one which is dehydrated only to 5 per cent moisture and stored for the same length of time, although the latter may be better when freshly dehydrated.

[3]*Quality* comprises such factors as palatability, appearance, nutritive value, and stability during storage.

Specifications for Wartime Dehydration Systems

Summarizing what we now know about vegetable dehydration, it appears that the following characteristics should be incorporated in a dehydration system which is to fit the realities and the urgencies of our wartime needs:

1. *It must produce a product of the highest quality consistent with large-scale practicability:* One consequence of this requirement is that the drying potential must be maintained as high as is safe and practicable throughout the process. High air temperature is desirable so long as the product maintains itself at a much lower temperature through evaporative cooling. A careful balance must be struck between damage caused by high product temperature and damage caused by slow drying.

2. *It must permit a low final moisture content to be attained:* In order to meet this requirement the product must be finished under conditions of high drying potential.

3. *It must give substantially uniform treatment to all pieces of the product:* High quality cannot be expected if the product consists of a heterogeneous mixture of scorched and underdried pieces.

4. *It must turn out maximum output per unit of scarce metals used in construction:* While there is no precise way to equate different scarce materials and equipment, the principle must be followed faithfully. Too often it comes into collision with an engineer's natural desire to build a substantial permanent unit which will be a credit to him in peacetime. The principle should apply to scarce

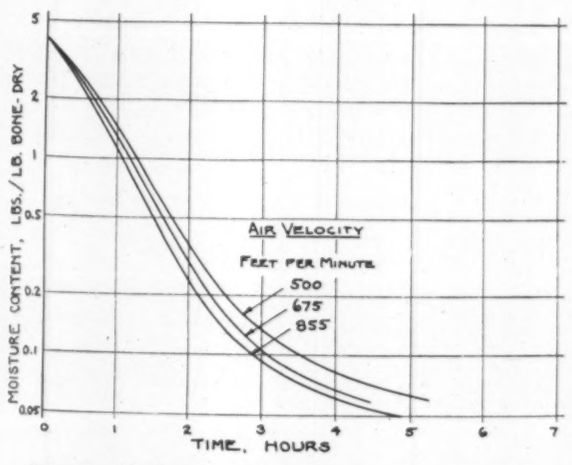


Fig. 5—Drying curves at different air velocities

Russet potato, blanched 5/32-in. strips, wood-slat tray, load 1.5 lb per square foot, cross-circulation, air temperature 150 F, wet-bulb temperature 90 F.

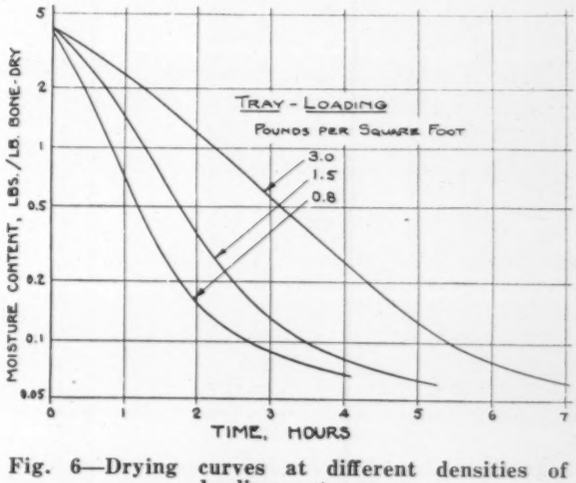


Fig. 6—Drying curves at different densities of loading on trays

Russet potato, blanched 5/32-in. strips, wood-slat tray, cross-circulation, air velocity 500 fpm, air temperature 150 F, wet-bulb temperature 90 F.

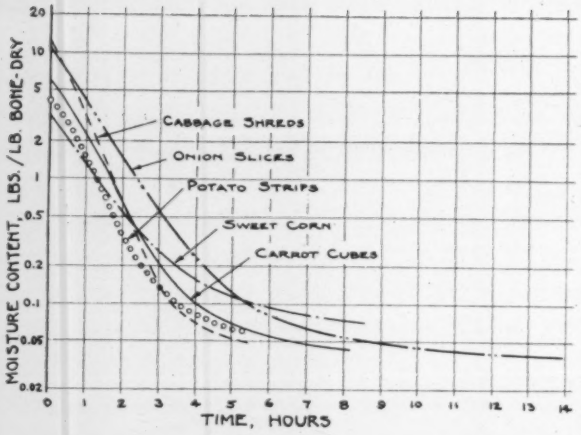


Fig. 7—Drying curves for several common vegetables
Russet potato strips, Chantenay carrot cubes, Cannonball cabbage shreds, sweet corn, Yellow Globe onions. Varying loads per square foot of tray. Air velocity 500 fpm, air temperature 150 F (onions 140 F), wet-bulb temperature 90 F.

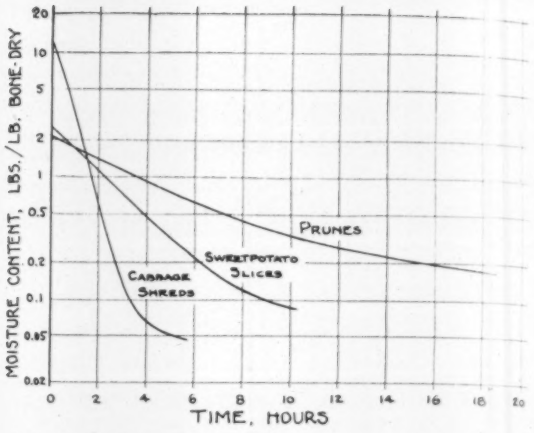


Fig. 8—Drying curves for a stone fruit and two vegetables

skilled labor as well as to materials. Common sense suggests, however, that shoddy construction is no more justified in wartime than at any other time. Freedom from breakdowns and from expensive repairs and replacements may, indeed, be more important now than normally.

The pressure for high output per unit of equipment is a force which favors multi-stage dehydration. A comparatively small predrier can evaporate three-quarters or more of the total moisture very rapidly. The last few percent of moisture may be evaporated in a bin type of finishing drier. The main drier can thus be liberated to do only the part of the job it can handle most effectively. The really good dehydration system will use a type of equipment at each stage which corresponds to the properties of the material at that stage.

5. *It must not require excessive operating labor:* Wartime manpower shortages will become increasingly serious. The proper balance between mechanization, using more metals and machine work, and pure hand operation, using more labor, will be difficult to strike justly; it may vary from one plant to the next. In some types of dehydraters no amount of labor can obviate the need for automatic control instruments. The shortage of such instruments is so acute, however, that the design should, if possible from other standpoints, be based on a type which requires only a minimum of automatic control. The designer must bear in mind that simplicity of control is going to be essential during the next few years, because dehydrater operators will often be only semi-skilled men or women.

6. *Control devices must be flexible and precise:* Vegetable dehydration by present standards demands accurate control of drying conditions. In the case of some vegetables the margin between desirable rapid drying and scorching is very narrow. Flexibility is essential not only so that the necessary compensations can be made for changing weather conditions, but also because most dehydraters must handle any one of several vegetables satisfactorily.

Suggestions to Dehydrater Designers

These wartime requirements open a wide field to the designer of dehydraters. In particular, the multi-stage process offers almost limitless possibilities. Methods that would be open to serious doubt as to utility or economy if used for the entire drying process may fit naturally into one stage of a composite operation.

In the past there has been a strong tendency for designers to work out a single design, possibly to patent some feature of it, and then concentrate on that one design, and that one only, for every job. Equipment concerns have come to be known for their own characteristic types of driers. There are now scores of these competing *systems*. Most of them are advertised in terms which suggest that they are panaceas. We think the fact is that most plants need a tailor-made job, not a ready-made off the rack. We should like to see the equipment concerns undertake to design and build for a plant whatever type of dehydrater best fits its actual needs. If the proper equipment for a certain plant is a continuous-belt predrier, then a tunnel, and finally a vacuum finisher, then there should be engineering firms with enough catholicity of outlook, enough breadth and tolerance, to prescribe just that and not to insist that it shall be called somebody's *system*.

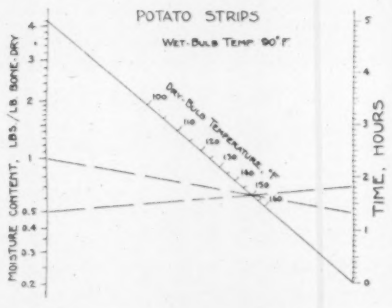


Fig. 9—Partial nomograph for drying time
Russet potato strips, wood-slat tray, cross-circulation, air velocity 500 fpm.

Finally, we must warn about the uselessness of designing dehydraters without a real knowledge of the way a modern dehydration plant operates. No matter how right the design is from a theoretical standpoint, it is wrong if it does not fit smoothly into the necessary framework of operations in a plant. There is no substitute for actual knowledge of these operations. Firms and consultants in this field are, however, urged to familiarize themselves also with the technological work in dehydration which is being carried on in U. S. Department of Agriculture laboratories. Since a large part of this work is still unpublished, personal visits will be found to be much more satisfactory than correspondence.

SUMMARY OF LOCAL CHAPTER MEETINGS

Chapter	Meeting Date	Subject	Speakers	Other Features	Attendance	Attendance Ratio*
New York	February 15	Influences of Air Conditioning on Theories of Ventilation.	W. H. Driscoll.	Alfred J. Offner presented Life Membership Certificate to G. M. Scott.	48	0.24
Ontario	February 1	Moving Pictures entitled "Flow."		Chapter Nominating Committee: H. B. Jenney, Chairman; R. M. Bayles, and J. A. Clifton. Chairman of Entertainment Committee, H. G. S. Murray.	55	0.51
Massachusetts	January 19	The important part Turbo Superchargers are playing in winning the war.	W. A. Reeves.	Combined meeting with Engineering Societies of New England.		
Montreal	January 18	Installation of Warm Air Heating Systems in Aeroplane Hangars.	H. G. Murray, Canadian Comstock Co., Ltd., Toronto.		32	0.66
Philadelphia	January 14	Annual banquet.		Entertainment.	160	1.33
Manitoba	January 13	Canada's Coal Problem.	C. P. Burgess, Managing Secretary, Western Canada Fuel Association.	Instructions to Chapter Delegate to 49th Annual Meeting.	20	0.76
Southern California	January 13	Heating, Ventilating and Air Conditioning Problems encountered in wartime.	Lieut.-Col. H. W. Thompson.	General Discussion Meeting date changed to Second Wednesday.	51	0.41
Cincinnati	January 12	49th Annual Meeting Committee's report.	Albert Buenger, General Chairman, G. B. Houliston, I. B. Helburn, H. E. Sproull, A. E. Edwards, and W. H. Junker.		25	0.58
Illinois	January 11	Function of the Civil Engineer Corps in Naval Establishments.	Comdr. E. B. Cary, USNR, Chief Public Works Officer, U. S. Naval Training Station, Great Lakes, Ill.		69	0.52
Kansas City	January 11	Civilian Defense.	Capt. R. L. Moulton, Asst. Fire Chief, and Chief of Air Raid Wardens, Kansas City, Kans.	L. T. Mart, Program Committee Chairman, announced speakers for next meetings. J. M. Arthur told about WPB conference in Kansas City on January 29. E. K. Campbell discussed suggested changes in Nominating Committee rules. Carl Clegg moved that Chapter approve Mr. Campbell's suggestion. Seconded by L. A. Stephenson and motion was carried.	19	0.40
North Texas	January 11	Training and Purpose of Texas Defense Guard.	Maj. Earle Cabell, Texas Defense Guard.	Election of Officers: President, M. L. Brown; Vice-President, L. C. McClanahan; Secretary-Treasurer, E. T. Gessell.	31	0.60

Chapter	Meeting Date	Subject	Speakers	Other Features	Attendance	Attendance Ratio*
St. Louis	January 5	The Engineer and War Production. Discussion of Some Practical Pointers on Temperature Control, by William Goodman.	Lloyd Sherrill of Bonded Personnel. B. C. Simons.		19	0.33
Washington, D. C.	December 9	Heating the Army.	B. F. McLouth.		26	0.26
Michigan	January 18	Future Sources of Power.	Max. Benjamin, Engineer, Detroit Edison Co.	Chapter was Guest of Detroit Edison Co.	97	1.02
	December 14	Forced Hot Water Heating.	R. E. Moore, Vice-President, Bell & Gossett Co.	U. S. Navy Movies. Service with the Navy. A Day in the Navy.	71	0.75
	November 16	Rating and Performance of Warm Air Furnace plants.	Prof. A. P. Kratz, University of Illinois. A. V. Hutchinson, ASHVE Secretary.	Movies — The Tanks Are Coming.	69	0.73
	October 5	Years Ahead.	J. W. Parker, Pres., ASME.	Movies of Chapter Golf Tournament.	66	0.69

* The attendance ratios shown represent the meeting attendance divided by the Chapter membership. These will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by other local chapters, and may be helpful in deciding on subjects for other chapter meetings.

Candidates for Membership

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the Journal of the Society or sent to the members in other approved manner as ordered by the Council. When replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 37 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge the members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by March 16, 1943, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

CANDIDATES	REFERENCES	
	Proposers	*Seconders*
Bade, Rudolph E., Dist. Mgr., B. F. Sturtevant Co., Kansas City, Mo.	M. M. Rivard J. H. Kitchen	D. M. Allen O. E. Harbordt
Bloomster, Edgar L., Consulting Engr., San Francisco, Calif.	F. W. Kolb J. F. Kooistra	G. M. Simonson N. A. Melnick
Caskey, Thomas C., Dist. Engr., B. F. Sturtevant Co., Seattle, Wash.	H. T. Griffith R. D. Morse	L. Bouillon R. E. LeRiche
Coad, J. Dennis, Owner, Air Conditioning Service Co., St. Louis, Mo.	W. J. Oonk D. J. Fagin	G. B. Rodenheiser B. C. Simons
Epple, Arnet B., Instructor, Michigan College of Mining & Technology, Houghton, Michigan. (*Reinstatement*)	R. R. Seeber *A. P. Young	*W. C. Polkinghorne *E. P. Wiedenhoefer
Fitzmorris, Thomas B., Power Supt., General Mills, Kansas City, Mo.	L. T. Mart J. M. Arthur, Jr.	D. M. Allen W. A. Russell
Garrison, Christopher H., Mfrs. Repr., Kansas City, Mo.	D. M. Allen W. A. Russell	O. A. Forslund L. T. Mart
Ginsberg, Maxwell R., Vice-Pres., Brunswick Appraisal Corp., Jamaica, N. Y.	*Martin Nelson *C. L. Spray	*Kenneth Fisk *Frederick Jantzen
Hall, John A., Sales Engr., A. L. Vanderhoof, Inc., Cleveland, Ohio.	A. L. Vanderhoof W. M. Rowe	E. W. Gray D. L. Taze
Hansen, Willis A., Mech. Engr., A. A. Coddington, San Francisco, Calif.	James Gayner G. M. Simonson	E. C. Cooley D. I. Murphy

HARVEY, ERNEST W., Application Engr., Westinghouse Electric & Manufacturing Co., Kansas City, Mo.

HILL, VAUGHN H., Mech. Engr., Board of Water & Electric Light Comm., Lansing, Mich. (*Advancement*)

HOLMAN, EARL L., Sr. Engr., District Engr. Office, U. S. Army, Honolulu, T. H.

HONEY, ROBERT L., Sales Engr., McQuay, Inc., Minneapolis, Minn.

HOW, RALPH F., Htg. Engr., U. S. Engineering Co., Kansas City, Mo.

HUNKEN, WALTER L., Regional Mgr., B. F. Sturtevant Co., Greensboro, N. C.

KEELING, FRED V., Assoc. Mech. Engr., U. S. Navy Yard, Philadelphia, Pa. (*Advancement*)

MARSHALL, JAMES, Asst. Chief Engr., The Bahnson Co., Winston-Salem, N. C. (*Advancement*)

MOSS, ALFRED W., Dept. Mgr., Walter Woods, Ltd., Winnipeg, Man., Canada.

OWEN, WILLIAM H., Mech. Engr., Harry Cooper Supply Co., Springfield, Mo.

PALMER, CECIL N., Mgr., Stoker Div., Pease Foundry Co., Ltd., Toronto, Ont., Canada.

PARSONS, FELIX N., Assoc. Mech. Engr., U. S. Nitrate Plant No. 2, Wilson Dam, Alabama.

PATTERSON, JAMES L., Works Engr., Canada Cycle & Motor Co., Ltd., Weston, Ontario, Canada.

PECK, ROBERT E., Vice-Pres., The Peck, Hannaford & Briggs Co., Cincinnati, Ohio.

PENTECOST, RICHARD H., Sales Mgr., Airtherm Manufacturing Co., St. Louis, Mo.

PIERPOINT, HARRY Y., Owner, J. A. Pierpoint, Washington, D. C.

RICHARDSON, FRANK C., JR., Sales Engr., A. L. Vanderhoof, Inc., Cleveland, Ohio.

ROBINSON, KENNETH E., Engr., Lansing, Mich. (*Advancement*)

RUSSELL, W. L. A., Chief Engr., Skinner Heating & Ventilating Co., Inc., St. Louis, Mo. (*Reinstatement*)

SCOTT, JAMES, Branch Mgr., York Ice Machinery Corp., Cincinnati, Ohio.

SINISH, WILLIAM R., Designing Engr., Wyatt C. Hedrick, Ft. Worth, Tex.

SMITH, ERNEST T., Engr., The Detroit Edison Co., Detroit, Mich.

STOUT, ARTHUR G., Chief Mech. Engr. for associated contractors, Park Ridge, Ill.

SULLIVAN, WILLIAM H., President, W. H. Sullivan Co., Inc., Greensboro, N. C.

TASNEY, JOHN S., Mgr., Parker Building Specialties, Inc., San Francisco, Calif.

WALTERS, JOSEPH K., Engr., Robert Schoenijahn, Cons. Engr., Wilmington, Del.

WILSON, DONALD P., Chief Draftsman, McQuay, Inc., Minneapolis, Minn.

*Non-Member.

L. T. Mart	D. M. Allen
M. M. Rivard	J. M. Arthur, Jr.
J. W. Miller	C. H. Pesterfield
L. G. Miller	S. H. Downs
G. M. Simonson	L. H. Cochran
E. C. Cooley	F. W. Hook
C. L. Bensen	W. H. Markson
C. N. Rink	E. H. Seelert
G. Nottberg	W. A. Russell
D. M. Allen	O. A. Forslund
F. P. Klages	E. W. Rietz
R. W. Sigmund	A. L. Hard
M. Sheffler	M. F. Blankin
G. F. Bertrand	H. H. Erickson
F. F. Bahnson	M. D. Brown
Arvin Page	Harry Hoffman
E. Anderson	P. L. Charles
I. McDonald	J. B. Steele
W. A. Russell	D. M. Allen
*R. W. Pauling	*Jack Cooper
H. B. Jenney	W. Philip
W. R. Blackhall	W. G. Eaton
Elmer Torok	*O. M. Weichsel
C. L. Kribs, Jr.	*W. H. Bundy
V. J. Jenkinson	R. S. Mathison
S. A. Jennings	D. O. Price
R. W. Sigmund	R. E. Kramig, Jr.
G. B. Houliston	Albert Buenger
G. Myers	*J. C. Watkins
*R. H. Kremer	*F. P. Kohlbry
E. J. Febrey	L. F. Nordine
W. H. Littleford	Glegge Thomas
E. W. Gray	W. M. Rowe
D. L. Taze	G. L. Tuve
C. Pesterfield	V. H. Hill
L. G. Miller	J. W. Miller
W. J. Oonk	W. C. B. Sodemann
L. W. Moon	E. E. Carlson
W. H. Junker	T. D. Boyd
A. L. Hard	O. W. Motz
C. E. Edwards	B. R. Miller
H. W. Skinner	E. H. Borg
J. H. Walker	G. D. Winans
E. E. Dubry	G. H. Tuttle
W. A. Kuechenberg	J. J. Philippi
R. M. Getschow	J. E. McClellan
F. E. P. Klages	Harry Hoffman
E. R. Harding	C. Z. Adams
R. A. Parker	C. E. Bentley
G. M. Simonson	C. L. Peterson
R. P. Schoenijahn	L. Macrow
E. H. Dafter	J. P. Stewart
J. F. Stafford	R. C. Colman
E. H. Seelert	C. N. Rink

Candidates Elected

In the past issues of the Journal of the Society the names of the following men were listed as Candidates for Membership. The membership grade of each candidate has been assigned by the Committee on Admission and Advancement and balloted upon by the Council. We are now instructed by the Council to post herewith, as required by Art. B-III, Sec. 8, of the By-Laws, the following list of candidates elected:

MEMBERS

CARSON, CLIFFORD C., Engr., U. S. Navy Dept., Washington, D. C. (*Reinstatement*)

DEAN, DAVID, 171 Radford St., Yonkers, N. Y. (*Reinstatement*)

JARVIS, GEORGE E., Vice Pres., Secy., A. E. Holmes & Bro. Co., Superior, Wis. (*Reinstatement*)

KNAB, EDWARD A., Owner, E. A. Knab Heating & Engineering Co., Milwaukee, Wis. (*Reinstatement*)

MILES, JAMES C., Research Engr., Geometric Stamping Co., Cleveland, Ohio. (*Reinstatement*)

ASSOCIATES

GABLE, HAROLD R., Design Engr., Union Steel Products Co., Albion, Mich. (*Reinstatement*)

WALSH, JAMES A., Pres., Air Conditioning Co., Houston, Tex. (*Reinstatement*)

JUNIORS

SCHOEN, DANIEL D., Mech. Engr., Brooklyn Navy Yard, Brooklyn, N. Y.

SPITZLEY, JOSEPH H., Engr., R. L. Spitzley Heating Co., Detroit, Mich. (*Reinstatement*)

WITTIG, FREDERICK E., Instructor, Pratt Institute, Brooklyn, N. Y. (*Reinstatement*)